General Specifications

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA	WSE-M4G323-A4
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (Yellow Color)	WSS-M97B51-A1
Pipe Sealant with Teflon® D8AZ-19554-A	WSK-M2G350-A2
Motorcraft MERCON® Super Premium 5W-20 Motor Oil XO-5W20-QSP	WSS-M2C153-H
Threadlock 262 E2FZ-19554-B	WSK-M2G351-A6

Engine Specifications

Description	Specification
GENERAL SPECIFICATIONS	
Displacement	4.6L (4V) (281 CID)
Number of Cylinders	8
Bore and Stroke	90.2 x 90.0 mm (3.55 x 3.54 inch)
Firing Order	1-3-7-2-6-5-4-8
Oil Pressure (HOT 1500 RPM)	138-310 kPa
Drive Belt Tension	[a]
Combustion Chamber Volume (cc)	52.6±0.5 cm [c]
Valve Seats	
· Width—Intake	1.8-2.2 mm (0.071-0.086 inch)
· Width—Exhaust	1.8-2.2 mm (0.071-0.086 inch)
· Angle	45 degrees
· Runout (T.I.R.) Max	0.05 mm (0.002 inch)
Valve Arrangement (Front-to-Rear) [c]	
· (Left Hand) Intake:	S-P-S-P-S-P-S-P
· Exhaust:	E-E-E-E-E-E-E-E
· (Right Hand) Intake:	P-S-P-S-P-S-P-S
· Exhaust: (C)	E-E-E-E-E-E-E-E
Valve Stem to Guide Clearance	
· Intake	0.020-0.069 mm (0.00078-0.00272 inch)
· Exhaust	0.046-0.095 mm (0.0018-0.0037 inch)

Valve Head Diameter	
· Intake	37 mm (1.46 inch)
· Exhaust	30 mm (1.18 inch)
· Gauge Diameters	35.0 and 28.0 mm (1.378-1.102 inch)
Valve Face Runout Limit	0.05 mm (0.002 inch)
Valve Face Angle	45.5 degrees
Valve Stem Diameter (Std)	
· Intake	6.975-6.995 mm (0.2754-0.2746 inch)
· Exhaust	6.949-6.970 mm (0.2744-0.2736 inch)
Valve Springs	
· Compression Pressure (N (Lb) @ Spec Length)	
· Intake	711.47 N @ 26.19 mm (159.9 Lb-Ft @ 1.031 inch)
· Exhaust	711.47 N @ 26.19 mm (159.9 Lb-Ft @ 1.031 inch)
· Free Length (Approximate)	
· Intake	42.16 mm (1.6598 inch)
· Exhaust	42.16 mm (1.6598 inch)
· Installed Pressure (N (Lb-Ft) @ Spec. Length)	
· Intake	289.1 N @ 36.14 mm (64.99 Lb-Ft @ 1.4228 inch)
· Exhaust	289.1 N @ 36.14 mm (64.99 Lb-Ft @ 1.4228 inch)
· Service Limit	10% Pressure Loss @ 28.02 mm (1.103 inch)
Roller Follower	
· Ratio	1.8:1
Hydraulic Lash Adjuster	
· Diameter (Std)	16.000-15.988 mm (0.6299-0.6294 inch)
· Clearance to Bore	0.018-0.069 mm (0.000709-0.002717 inch)
· Service Limit	0.016 mm (1.0006299 inch)
· Hydraulic Leakdown Rate [d]	5-25 seconds
· Collapsed Lash Adjuster Gap—Desired	0.80-1.20 mm (0.0315-0.0472 inch)
CAMSHAFT	
Theoretical Valve Lift @ Zero Lash	
· Intake (Primary)	10.0 mm (0.3937 inch)
· Intake (Secondary)	10.0 mm (0.3937 inch)
· Exhaust	10.0 mm (0.3937 inch)
End Play	0.025-0.165 mm (0.00098-0.00649 inch)
· Service Limit	0.190 mm (0.007480 inch)
Journal to Bearing Clearance	0.025-0.076 mm (0.00098-0.002992 inch)
· Service Limit	0.100 mm (0.003937 inch) MAX
Journal Diameter (All)	26.962-26.936 mm (1.0615-1.0605 inch)

Bearing Inside Diameter (All)	27.012-26.987 mm (1.0635-1.0625 inch)
Front Bearing Location	e
CYLINDER BLOCK	
· Head Gasket Face Flatness	0.15 mm (0.006 in) MAX overall
· Head Gasket Surface Finish b	
Main Bearing Bore Diameter	72.400-72.424 mm (2.8504-2.8513 inch)
CRANKSHAFT	
Main Bearing Journal Diameter	67.481-67.505 mm (2.6567269-2.6576718 inch)
Connecting Rod Journal	
· Diameter	52.983-53.003 mm (2.085941-2.086728 inch)
Crankshaft Free End Play	0.130-0.301 mm (0.005118-0.011850 inch)
Crankshaft Runout to Rear Face of Block	0.050 mm (0.01969 inch) MAX
Connecting Rod Bearings	
Clearance to Crankshaft	
· Desired	0.027-0.069 mm (0.0010629-0.0027165 inch)
· Allowable	0.027-0.069 mm (0.0010629-0.0027165 inch)
Bearing Wall Thickness (Std) f	1.920-1.928 mm (0.075591-0.075905 inch)
Main Bearings	
Clearance to Crankshaft	
· Desired	0.025-0.045 mm (0.00098-0.00177 inch)
· Allowable	0.025-0.050 mm (0.00098-0.00197 inch)
Bearing Wall Thickness (Std) f	2.451 mm (0.0965 inch)
Connecting Rod	
· Pin Bore Diameter	22.012-22.024 mm (0.86661-0.86708 inch)
· Crankshaft Bearing Bore Diameter	56.866-56.886 mm (2.23881-2.23960 inch)
· Length (Center-to-Center)	150.7 mm (5.933 inch)
Alignment (Bore-To-Bore Max. Diff.) g	
· Twist	0.050 per 25 mm (0.00197 per 0.9843 inch)
· Bend	0.038 per 25 mm (0.00150 per 0.9843 inch)
Side Clearance (Assembled to Crank)	
· Standard	0.15-0.45 mm (0.00591-0.01772 inch)
· Service Limit	0.50 mm (0.01969 inch) MAX
CYLINDER BORE AND PISTON	
Cylinder Bore	
Diameter h	
· Surface Finish (RMS)	0.2-0.6 Microns
· Out-of-Round Limit	0.015 mm
· Out-of-Round Service Limit	0.020 mm
· Taper Service Limit	0.006 mm
Piston	
· Diameter i	.028 mm (.0010 inch)

· Coded Red 1	90.167-90.188 mm (3.299-3.5505 inch)
· Coded Blue 2	90.180-90.195 mm (3.5504-3.5510 inch)
· Coded Yellow 3	90.198-90.208 mm
Coated Piston-to-Bore Clearance	-0.010/+0.026 mm (-0.0003937/+0.0010236 inch)
Pin Bore Diameter	21.9985-22.0025 mm (0.866081-0.866238 inch)
Ring Groove Width	
· Compression (Top)	1.230-1.250 mm (0.484-0.0492 inch)
· Compression (Bottom)	1.520-1.540 mm (0.05984-0.06062 inch)
· Oil Ring	3.030-3.055mm
Piston Pin	
· Length	61.601-62.030 mm (2.42523-2.44212 inch)
· Diameter	22.0005-22.0030 mm (0.8661596-0.8662581 inch)
Pin to Piston Fit [j]	-0.0045/+0.002 mm (-0.000177/+0.0000787 inch)
Pin to Rod Clearance	
· Standard	0.004-0.0175 mm (0.000157-0.00689 inch)
· Service Limit	0.035 mm (0.001378 inch)
Oil Ring	1.15 mm (0.04528 inch) MAX
· Side Clearance	.075-.1000 mm (.0030-.0040 inch)
· Compression (Top)	0.0090-0.0235 mm (0.000354-0.000925 inch)
· Compression (Bottom)	0.030-0.080 mm (0.00118-0.00315 inch)
· Oil Ring	Snug Fit
Ring Gap [k]	
· Compression (Top)	.150-.300 mm (.006-0.0018 inch)
· Compression (Bottom)	0.300-0.550 mm (0.0018-0.0022 inch)
· Oil Ring (Steel Rail)	0.15-0.66 mm (0.00591-0.02598 inch)
Piston Rings	
· Ring Gap	
· Compression (Top)	1.00 mm (0.03937 inch) MAX
· Compression (Bottom)	1.00 mm (0.03937 inch) MAX
· Service Limit	1.15 mm (0.04528 inch) MAX
LUBRICATION SYSTEM	
Oil Capacity (Quarts U.S.)	6 ± 0.25 [l]

[a] Newly Installed—Refers to the condition of the "NEW" drive belt before the engine has made no more than one rotation and before the belt has had a chance to stretch or seat into the pulley grooves.

[c] P=Primary, S=Secondary, E=Exhaust

[d] Time necessary for plunger to leak down 1.6 mm of travel with 222 N force and leak down fluid in tappet.

[e] Distance front edge of bearing is installed below front face of cylinder block.

[f] 0.050 Undersize—add 0.025 to standard thickness.

[g] Pin bore and crank bearing bore must be parallel and in same vertical plane within the specified total difference when measured at the ends of a 203 mm bar, 101.5 mm on each side of rod centerline.

[h] Cylinder Bore Diameter
Red—90.200-90.213
Blue—90.213-90.226
Yellow—90.226-90.239

[i] Measured at 42 mm from piston dome, at 90 degrees to the piston pin.
[j] Piston pin outer diameter is larger than piston pin bore, providing a possible interference fit.
[k] Specification in 90.200 mm diameter gauge.
[l] With installation of a new filter.

Drive Belt Tension

Belt Type	Belt Tension
6 Rib (Fixed) [a]	110-120 Lbs

[a] "Fixed" refers to systems with manually-adjusted centers which are bolted in place and considered fixed.

Torque Specifications

Description	Nm	lb-ft	lb-in
Camshaft sprocket bolt	115	85	—
Connecting rod bolt	a	a	a
Engine front cover bolt	a	a	a
Drive belt tensioner bolts	25	18	—
Cylinder head bolt	a	a	a
Pulley to crankshaft bolt	a	a	a
EGR valve to intake manifold	a	a	a
Exhaust manifold studs	25	18	—
Lower intake manifold-to-cylinder head bolt	a	a	a
Main bearing cap bolt	a	a	a
Oil filter adapter bolt	25	18	—
Oil bypass filter to adapter	50	37	—
Oil pump screen cover and tube-to-oil pump bolt	10	—	89
Oil pan-to-cylinder block bolt	a	a	a
Oil pan-to-engine front cover bolts	a	a	a
Oil pump-to-cylinder block bolt	10	—	89
Oil pump screen and pickup tube-to-main bearing cap stud spacer bolt	25	18	—
Coolant pump pulley bolts	25	18	—
Valve cover bolt	10	—	89
Coolant pump-to-cylinder block bolt	25	18	—
EGR valve to exhaust manifold tube nuts	40	30	—
Power steering pump to engine	25	18	—
Outlet heater hose stud bolts	25	18	—
Camshaft cap cluster to cylinder head	10	—	89
Timing chain tensioner bolts—primary	25	18	—
Timing chain tensioner bolts—secondary	10	—	89
A/C compressor bolts	25	18	—
Ignition coil cover bolts	10	—	89
Generator mounting bracket retainers	10	—	89

Flexplate bolts	80	59	—
Flywheel bolts	85	63	—
Torque converter nuts	36	27	—
Oil level indicator tube retainer	10	—	89
Primary timing chain guide-to-engine bolts	10	—	89
Oil pump screen and pickup tube spacer to main bearing stud	25	18	—
Accelerator cable bracket	10	—	89
Belt idler pulley bolt	25	18	—
Sub-frame brace nuts	41	30	—
Air intake scoop bolts	25	18	—
Air intake scoop bracket bolt	25	18	—
Air intake scoop bracket nuts	25	18	—
Air intake scoop bracket throttle body nut	9	—	80
Exhaust gas recirculation (EGR) vacuum regulator solenoid bolts	10	—	89

[a] Refer to the procedure.

Engine

WARNING: Do not operate the engine with the hood open until the fan blade has been first examined for possible cracks and separation.

The 4.6L (4V) (281 CID) is a V-8 engine with the following features:

- dual overhead camshafts
- four valves per cylinder
- sequential multiport fuel injection (SFI)
- an aluminum intake manifold
- aluminum cylinder heads
- a cast aluminum, 90-degree V- cylinder block
- individually chain-driven camshafts with a hydraulic timing chain tensioner on each timing chain
- the electronic ignition system with eight ignition coils

Identification

Always refer to these labels when replacement parts are necessary or when checking engine calibrations. The engine parts often differ within a CID family. Verification of the identification codes will ensure that the correct parts are obtained. These codes contain all the pertinent information relating to the dates, optional equipment and revisions. The Ford Master Parts Catalog contains a complete listing of the codes and their application.

Code Information

The engine code information label, located on the side of the valve cover and the front side of the valve cover, contains the following:

- engine build date
- engine plant code
- engine code

Exhaust Emission Control System

Operation and necessary maintenance of the exhaust emission control devices used on this engine is covered in the Powertrain Control/Emissions Diagnosis (PC/ED) manual.

Induction System

The sequential multiport fuel injection (SFI) provides the fuel/air mixture needed for combustion in the cylinders. The eight solenoid-operated fuel injectors:

- are mounted in the lower intake manifold.
- meter fuel into the air intake stream in accordance with engine demand.
- are positioned so that their tips direct fuel just ahead of the engine intake valves.

- are connected in series with the fuel pressure sensor.
- supply fuel from the fuel tank with a fuel pump mounted in the fuel tank.

A constant fuel pressure drop is maintained across the fuel injectors by the fuel pressure sensor. The fuel pressure sensor:

- is positioned upstream from the fuel injectors on the fuel injection supply manifold.

Valve Train

The valve train operates as follows:

- ball-tip hydraulic lash adjusters provide automatic lash adjustment.
- roller followers ride on the camshaft lobes, transferring the up-and-down motion of the camshafts to the valves in the cylinder heads.

Positive Crankcase Ventilation System

All engines are equipped with a closed-type positive crankcase ventilation system recycling the crankcase vapors to the upper intake manifold.

Lubrication System

The engine lubrication system operates as follows:

- oil is drawn into the oil pump through the oil pump screen cover and tube in the sump of the oil pan.
- oil is pumped through the oil bypass filter on the left front side of the cylinder block.
- oil enters the main oil gallery where it is distributed to the crankshaft main journals and to both cylinder heads.
- From the main journals, the oil is routed through cross-drilled passages in the crankshaft to lubricate the connecting rod bearings. Controlled leakage through the crankshaft main bearings and connecting rod bearings is slung radially outward to cool and lubricate the cylinder walls as well as the entire connecting rod, piston and piston rings assembly.
- The left cylinder head is fed from a drilling into the supply passage feeding the main gallery at the front of the cylinder block. The right cylinder head is fed from a drilling into the rear of the main gallery. Main gallery pressure is reduced as it enters the cylinder head galleries through fixed serviceable orifices located at the upper part of the feed passages. It is this reduced pressure in the cylinder head galleries which feeds the camshaft journals, the hydraulic lash adjusters and the primary and secondary timing chain tensioners.
- The camshaft lobe and roller followers are lubricated by splash created through valve train operation.

Oil Pump

The lubrication system of the 4.6L (4V) engine is designed to provide optimum oil flow to critical components of the engine through its entire operating range. The heart of the system is a positive displacement internal gear oil pump using top seal rotors. Generically this design is known as a gerotor pump, which operates as follows.

- The oil pump is mounted on the front face of the cylinder block.
- The inner rotor is piloted on the crankshaft post and is driven through flats on the crankshaft.

- System pressure is limited by an integral, internally-vented relief valve which directs the bypassed oil back to the inlet side of the oil pump.
- Oil pump displacement has been selected to provide adequate volume to ensure correct oil pressure both at hot idle and maximum speed.
- The relief valve calibration protects the system from excessive pressure during high viscosity conditions.
- The relief valve is designed to provide adequate connecting rod bearing lubrication under high-temperature and high-speed conditions.

Cooling System

The engine cooling system includes the following:

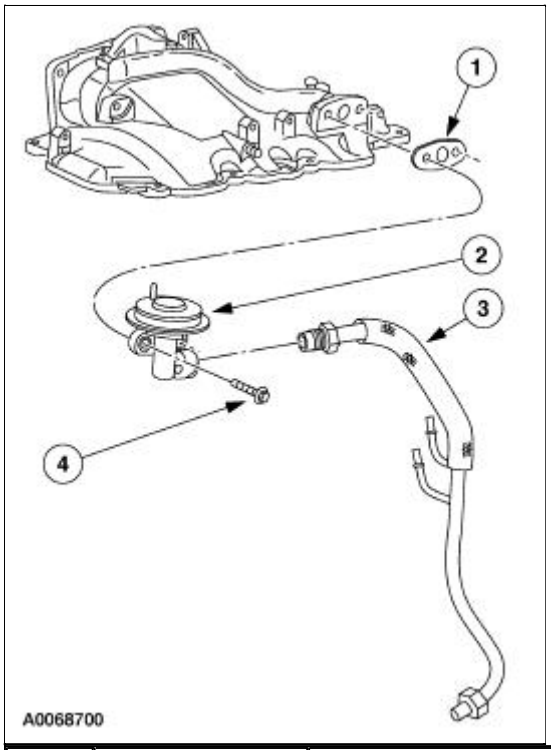
- radiator
- coolant pump
- the electric cooling fan motor and fan blade, activated by the variable control module
- the degas bottle, which aids in maintaining the correct volume of engine coolant
- thermostat
- upper radiator hose
- lower radiator hose
- heater coolant hoses

Drive Belt System

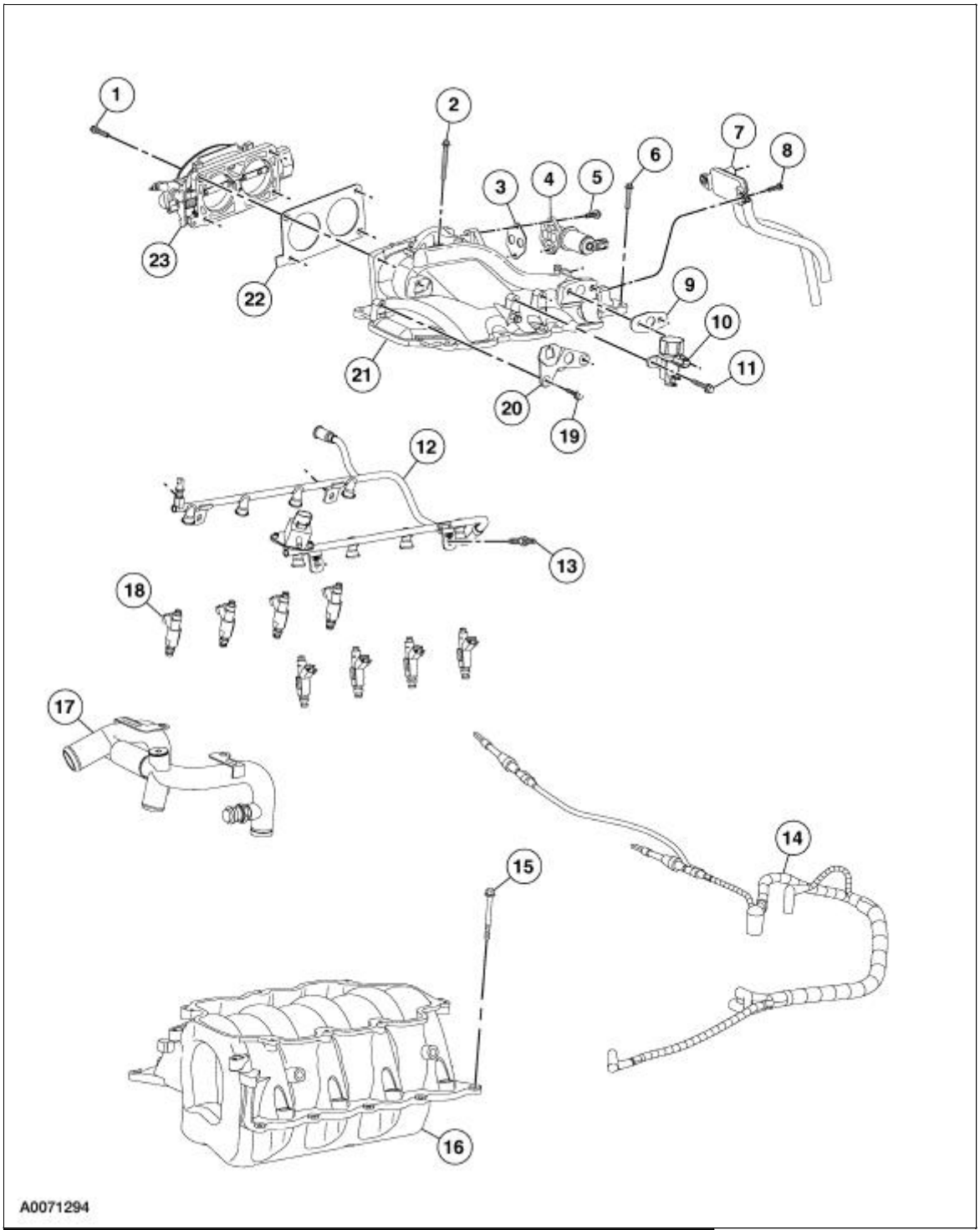
The 4.6L (4V) DOHC engine is equipped with a serpentine drive belt. To ensure maximum life, a replacement drive belt should be of the same type as originally installed.

- The accessories mounted on the front of the engine are belt-driven by the crankshaft.
- The serpentine drive belt is routed over each accessory pulley, driven by the crankshaft pulley bolted to the crankshaft.

For service procedures, including tensioning, refer to Section 303-05 .

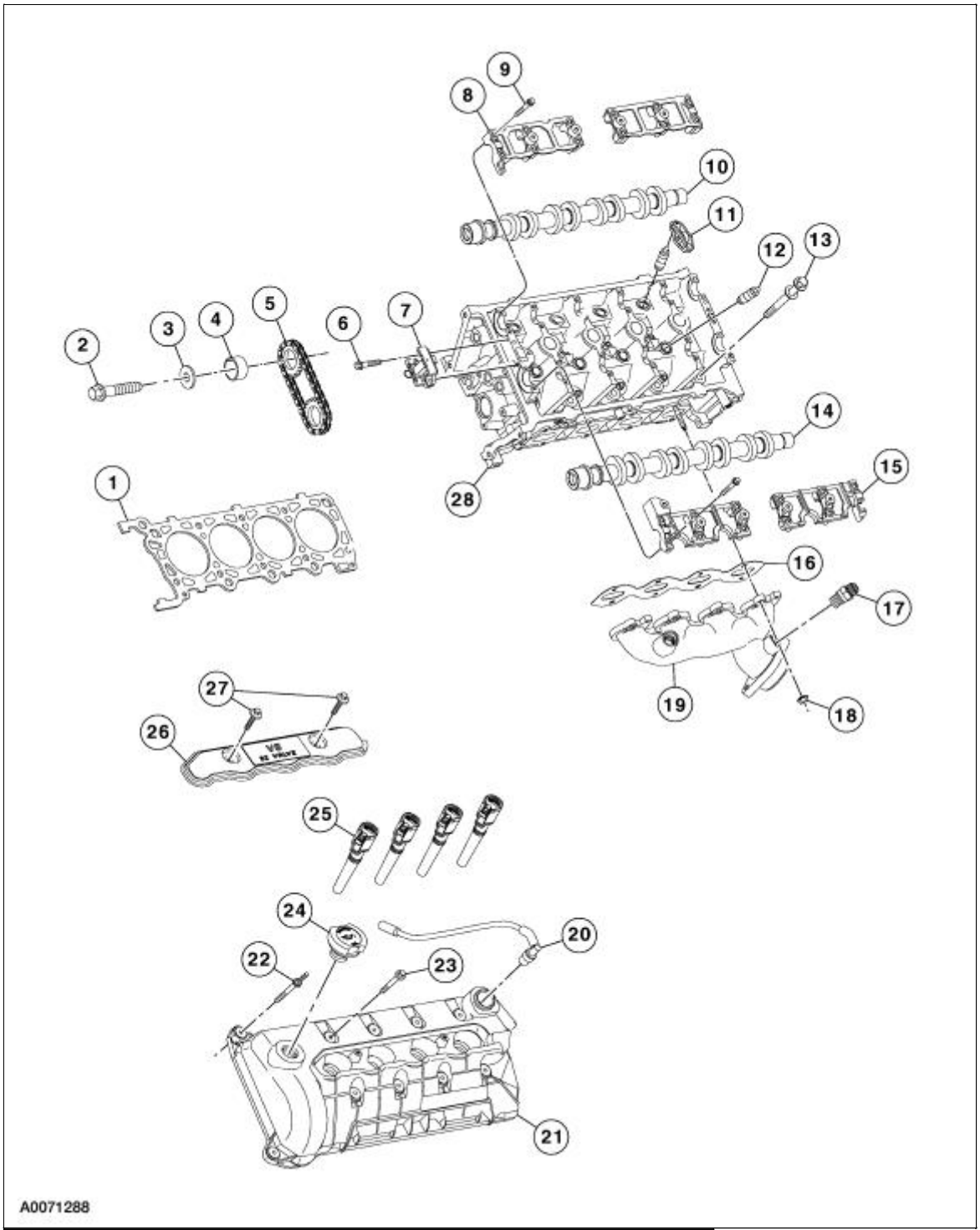


Item	Part Number	Description
1	9D476	EGR valve gasket
2	9D460	EGR valve
3	9D477	EGR valve-to-exhaust manifold tube
4	W701625	Bolt (2 req'd)



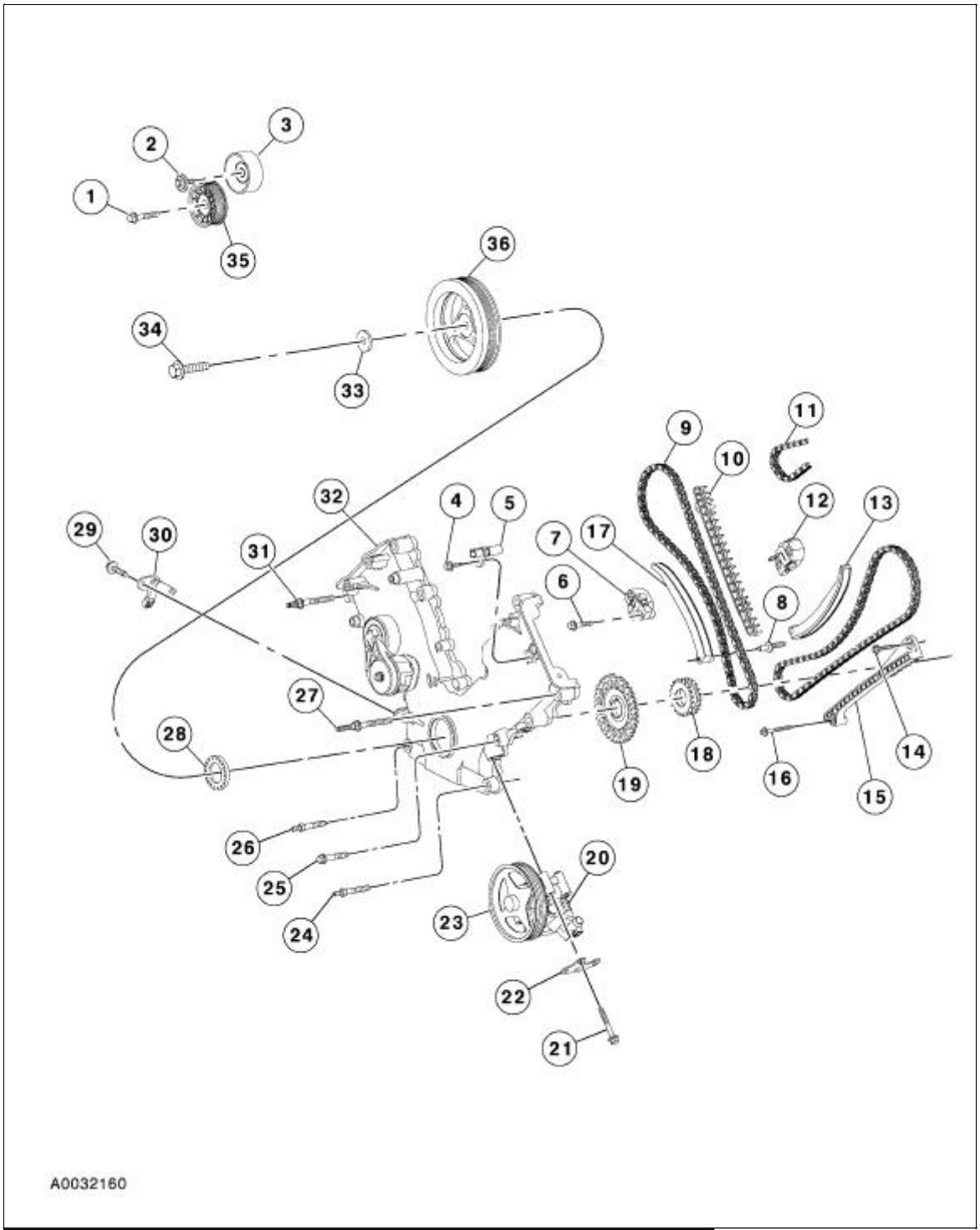
Item	Part Number	Description
1	N806154	Bolt (4 req'd)
2	N705654	Bolt
3	9F670	Idle air control valve gasket
4	9F715	Idle air control valve
5	N806154	Bolt (2 req'd)
6	N806154	Bolt (5 req'd)
7	9J433	Differential pressure feedback EGR
8	W701557	Screw (2 req'd)

9	9D476	EGR valve gasket
10	9J459	EGR vacuum regulator solenoid
11	W701557	Bolt (2 req'd)
12	9F792	Fuel injection supply manifold
13	N811449	Stud (4 req'd)
14	9E498	Vacuum harness
15	W704682	Bolt (10 req'd)
16	9J447	Intake manifold (lower)
17	8548	Coolant crossover
18	9F593	Fuel Injector (8 req'd)
19	N605892	Bolt (2 req'd)
20	9728	Bracket
21	9424	Intake manifold (upper)
22	9E936	Throttle body gasket
23	9E926	Throttle body



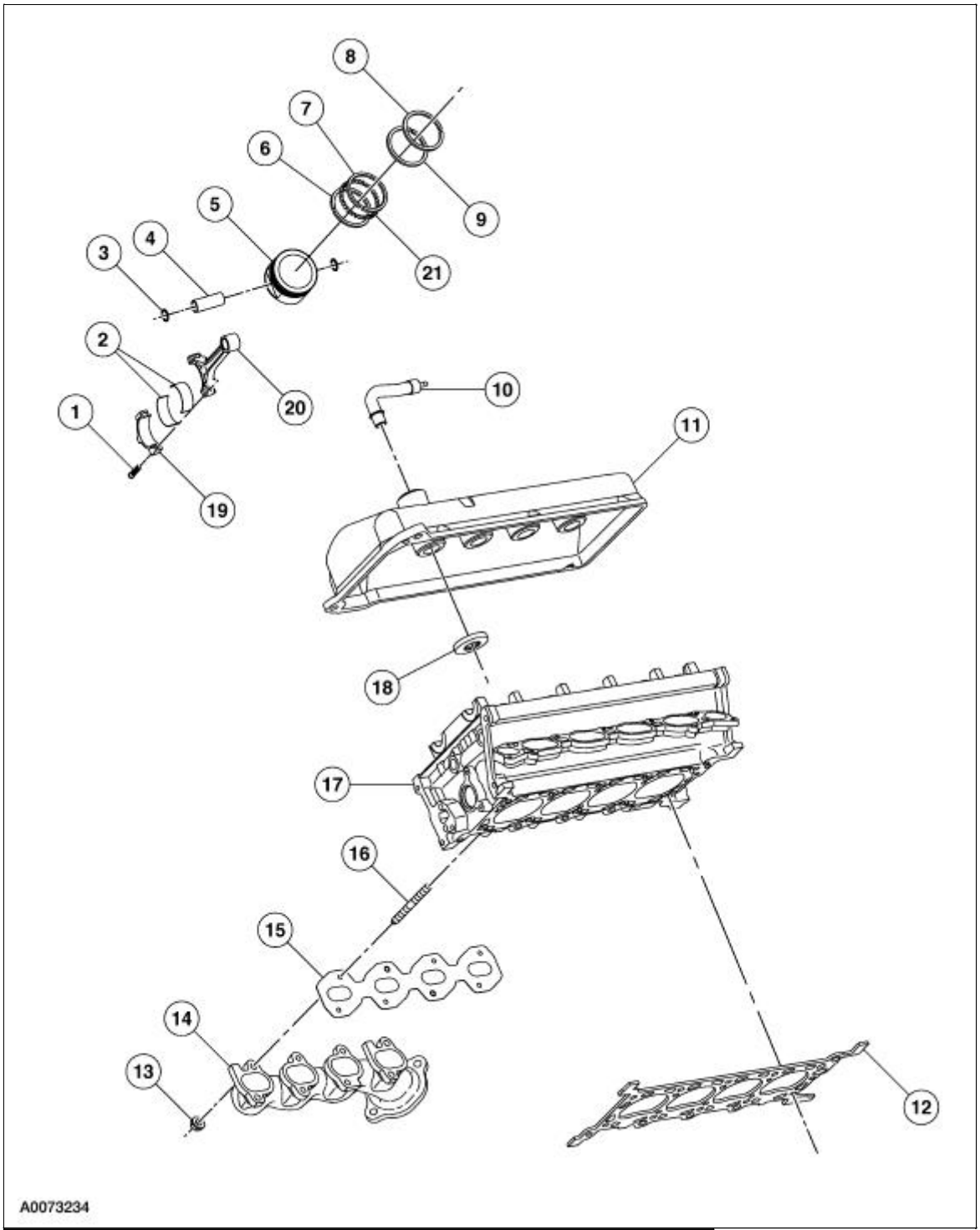
Item	Part Number	Description
1	6083	Cylinder head gasket
2	—	Bolt (2 req'd)
3	—	Washer (2 req'd)
4	6255	Spacer
5	—	Secondary timing chain (2 req'd)
6	—	Screw and washer
7	6C271	Timing chain vibration damper
8	6B277	Camshaft bearing cap

9	—	Bolt (24 req'd)
10	6A271	Camshaft
11	6529	Roller follower (8 req'd)
12	6C501	Hydraulic lash adjuster
13	6065	Bolt (20 req'd)
14	6A273	Camshaft
15	6B278	Camshaft bearing cap (2 req'd)
16	9448	Exhaust manifold gasket
17	9F485	EGR valve tube to manifold connector
18	W701706	Nut (8 req'd)
19	9431	Exhaust manifold
20	6C324	PCV tube
21	6A505	Valve cover
22	W708442	Stud bolt (4 req'd)
23	N808199	Bolt (16 req'd)
24	6766	Oil filler cap
25	12A366	Ignition coils
26	6P068	Ignition coil cover
27	N807309	Bolt (4 req'd)
28	6050	Cylinder head



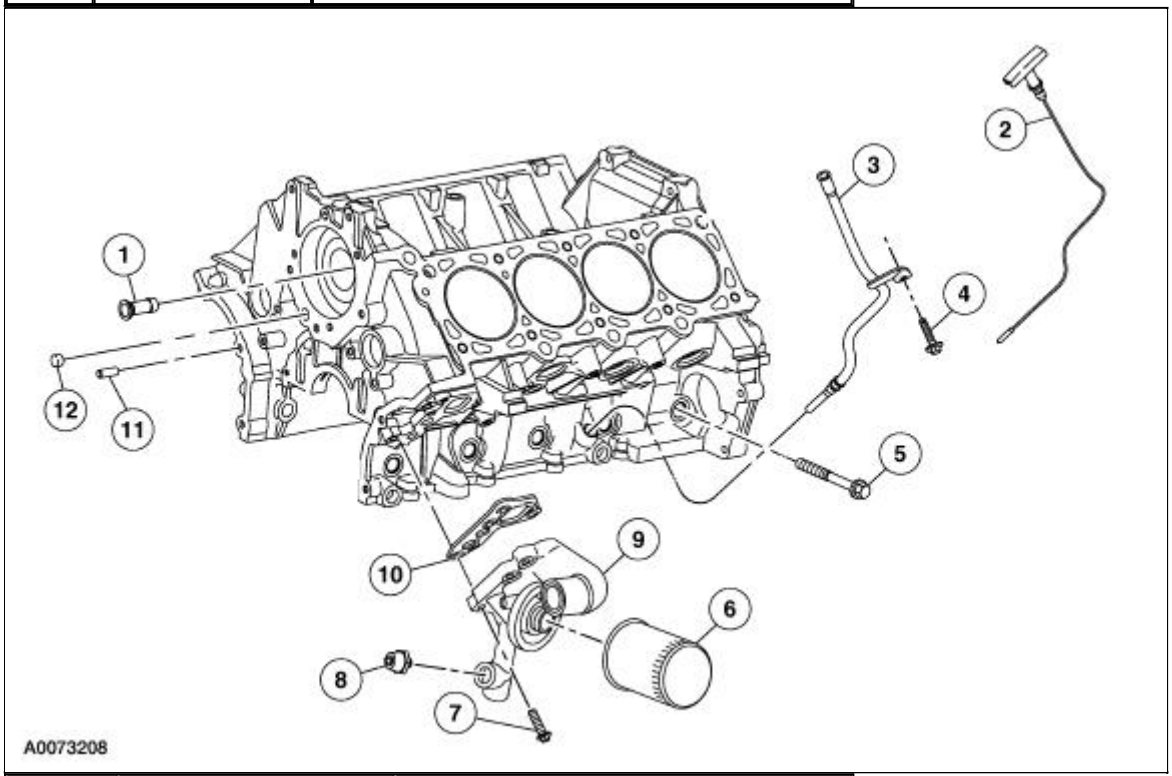
Item	Part Number	Description
1	N808102	Bolt
2	N808102	Bolt
3	19A216	Belt idler pulley
4	N806155	Bolt
5	6B288	Camshaft position sensor
6	N606543	Bolt (4 req'd)
7	6L266	Timing chain tensioner
8	W705803	Stud

9	6268	Timing chain (2 req'd)
10	6K297	Timing chain guide
11	6268	Timing chain (2 req'd)
12	6M269	Timing chain tensioner
13	6L253	Timing chain tensioner arm
14	N605893	Bolt (4 req'd)
15	6K297	Timing chain guide
16	N804958	Bolt (2 req'd)
17	6L253	Timing chain tensioner arm
18	6306	Crankshaft sprocket
19	12A227	Ignition pulse ring
20	3A696	Power steering pump
21	N806176	Bolt (4 req'd)
22	3R801	Gasket
23	3A696	Power steering pump pulley
24	W706508	Stud
25	N806177	Bolt (8 req'd)
26	N808586	Stud
27	N806300	Stud (4 req'd)
28	6700	Crankshaft front seal
29	N806155	Bolt
30	6C315	Crankshaft position sensor
31	W706560	Stud
32	6C086	Engine front cover
33	N806165	Washer
34	N806139	Bolt
35	19A216	Belt Idler Pulley
36	6316	Crankshaft pulley



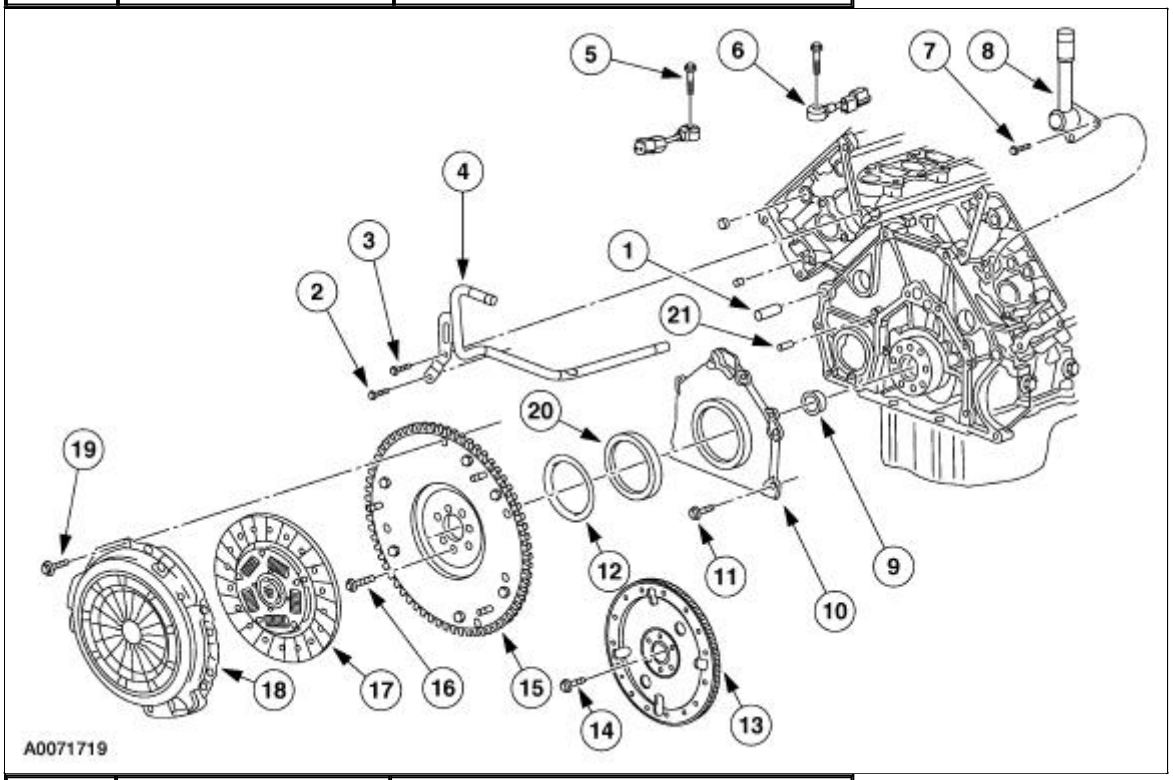
Item	Part Number	Description
1	6214	Bolt (2 req'd)
2	6211	Connecting rod bearing (16 req'd)
3	6140	Piston pin retainer (16 req'd)
4	6135	Piston pin (8 req'd)
5	6110	Piston (8 req'd)
6	6159	Piston ring (8 req'd)
7	6159	Piston ring (8 req'd) (part of 6100)
8	6150	Piston ring (8 req'd) (part of 6100)

9	6152	Piston ring (8 req'd)
10	6758	Crankcase vent tube and connector
11	6582	Valve cover
12	6051	Cylinder head gasket
13	W701706	Nut (8 req'd)
14	9430	Exhaust manifold
15	9448	Exhaust manifold gasket
16	W701681	Stud (8 req'd)
17	6049	Cylinder head
18	6C527	Spark plug gasket (8 req'd)
19	6200	Connecting rod (8 req'd)
20	6200	Connecting rod (8 req'd)
21	6161	Piston ring (8 req'd)

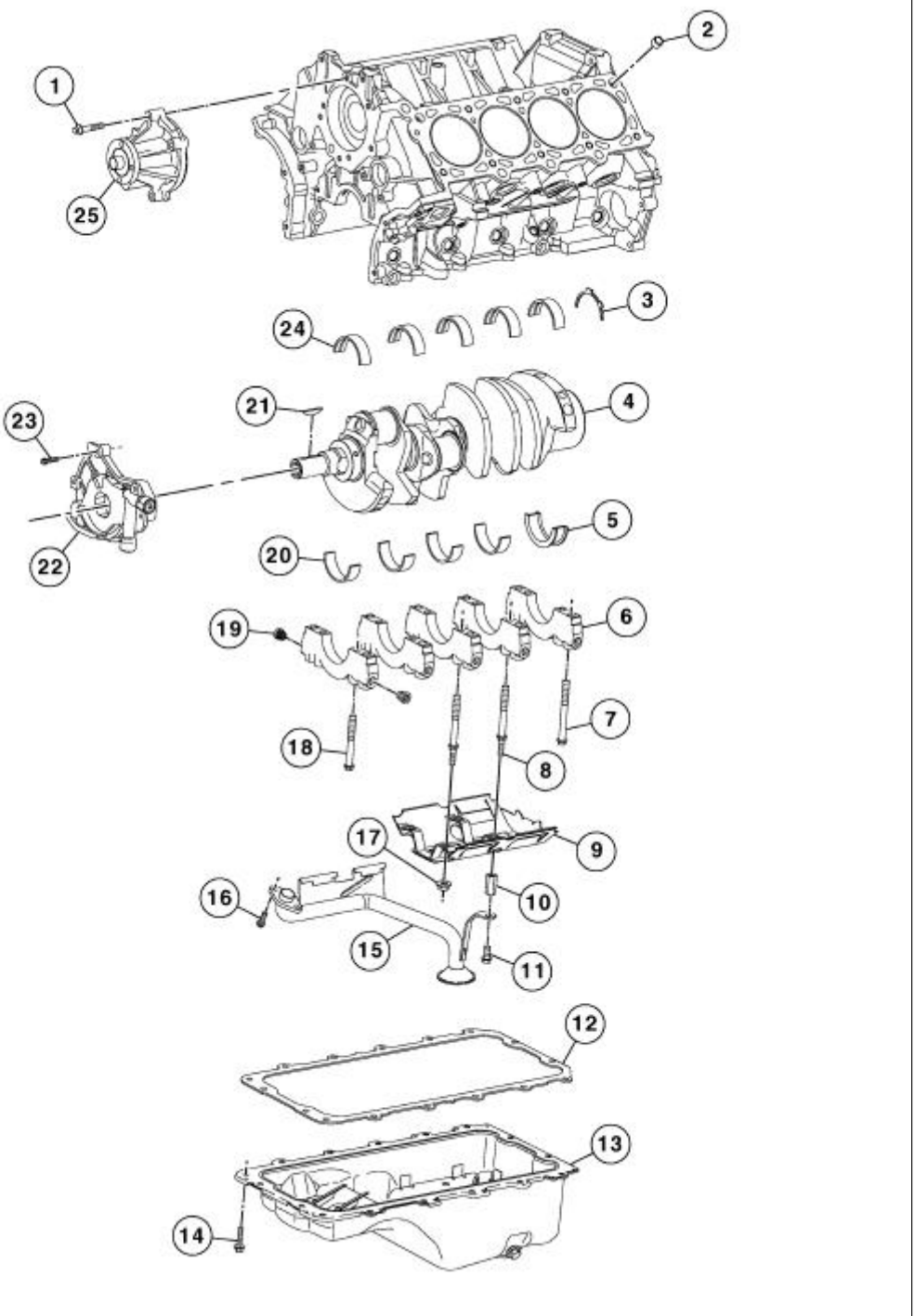


Item	Part Number	Description
1	8555	Coolant bypass tube
2	6750	Oil level indicator
3	6754	Oil level indicator tube
4	N806155	Bolt
5	6C358	Bolt (10 req'd)
6	6714	Oil bypass filter
7	N806156	Bolt (4 req'd)
8	9278	Oil pressure sender
9	6881	Oil filter adapter
10	6A636	Oil filter adapter gasket

11	N620482	Dowel
12	87836	Plug



Item	Part Number	Description
1	N807198	Dowel pin (2 req'd)
2	N807309	Bolt
3	N807959	Bolt
4	18663	Heater water hose
5	W500110	Bolt (2 req'd)
6	12A699	Knock sensor (2 req'd)
7	N807309	Bolt (2 req'd)
8	18696	Heater water hose
9	7120	Pilot bearing
10	6K318	Crankshaft rear retainer
11	N806155	Bolt (6 req'd)
12	6310	Crankshaft oil slinger
13	6375	Flexplate
14	N806168	Bolt (6 req'd)
15	—	Flywheel
16	N808139	Bolt (8 req'd)
17	7550	Clutch disc
18	7563	Clutch pressure plate
19	N808969	Bolt (6 req'd)
20	6701	Crankshaft rear oil seal
21	N806007	Dowel pin (2 req'd)



Item	Part Number	Description
1	N806177	Bolt (4 req'd)
2	N806459	Dowel (4 req'd)
3	6A341	Thrust washer
4	6303	Crankshaft
5	6A339	Thrust bearing
6	6325	Main bearing cap (5 req'd)
7	6345	Bolt (10 req'd)
8	6K258	Stud (4 req'd)

9	6687	Oil pan baffle
10	N806180	Spacer
11	N605904	Bolt
12	6710	Oil pan gasket
13	6675	Oil pan
14	W701240	Bolt (16 req'd)
15	6622	Oil pump screen pickup and tube
16	N806155	Bolt (2 req'd)
17	N806180	Nut (2 req'd)
18	6345	Bolt (6 req'd)
19	6C360	Main bearing cap adjusting screw (10 req'd)
20	6A338	Crankshaft main bearing (4 req'd)
21	N806201	Woodruff key
22	6621	Oil pump
23	N806183	Bolt (4 req'd)
24	6333	Crankshaft main bearing
25	8501	Coolant pump

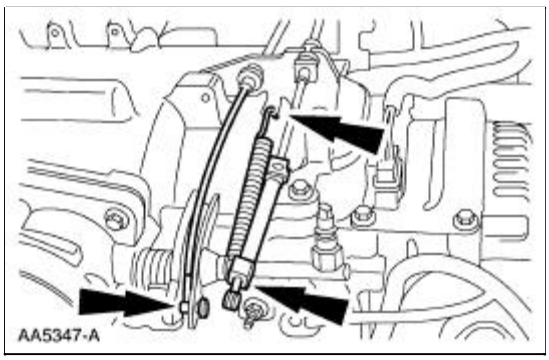
Engine

Refer to Section 303-00 for basic mechanical concerns or refer to the Powertrain Control/Emissions Diagnosis (PC/ED) manual for driveability concerns.

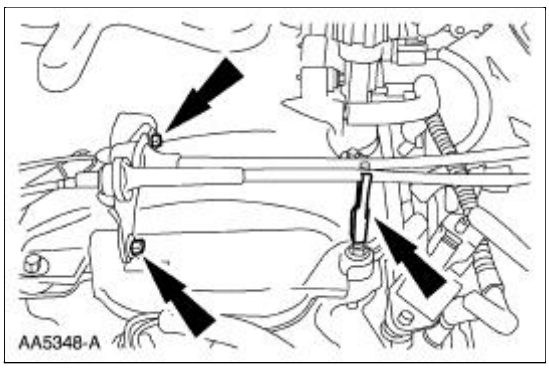
Intake Manifold —Upper

Removal

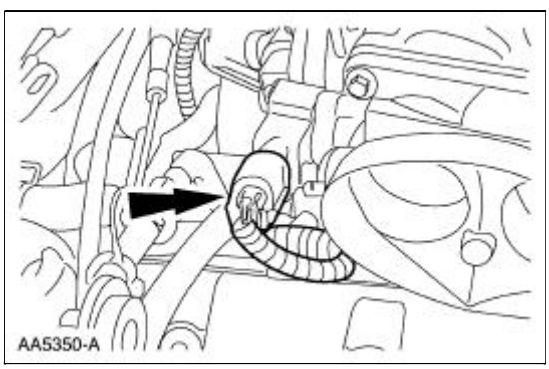
1. Remove the air intake scoop bracket. For additonal information, refer to Section 303-12 .
2. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
3. Disconnect the accelerator cable, the speed control actuator cable and the return spring.



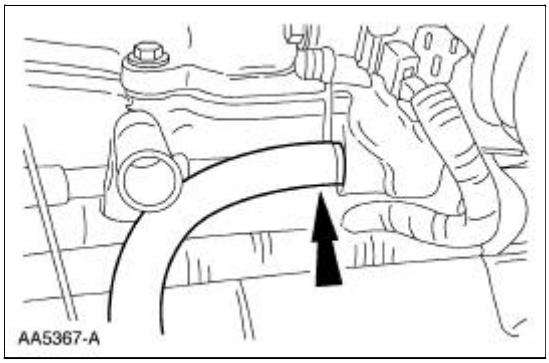
4. Remove the bolts, disconnect the clip and position the cables out of the way.



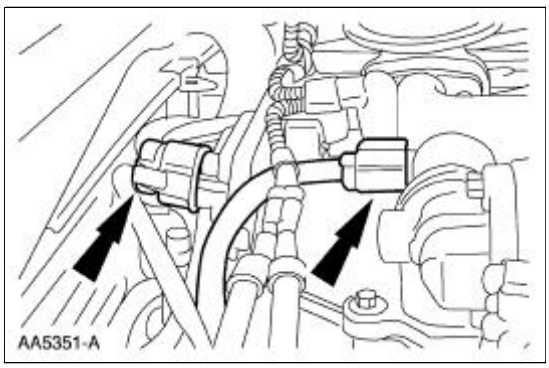
5. Disconnect the throttle position (TP) sensor.



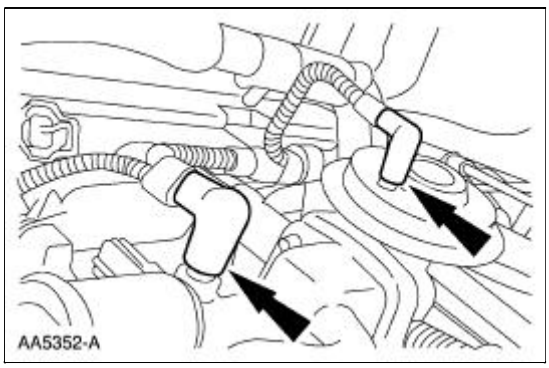
6. Disconnect the evaporative emissions (EVAP) return hose.



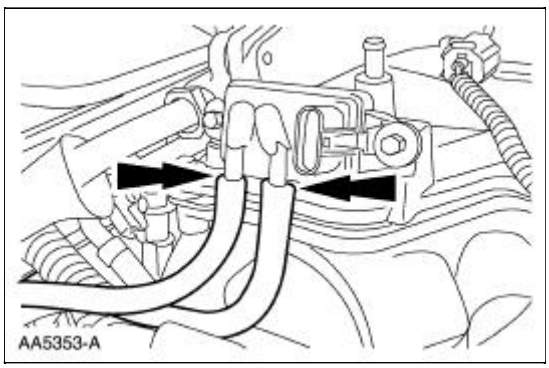
7. Disconnect the idle air control valve and the differential pressure feedback EGR.



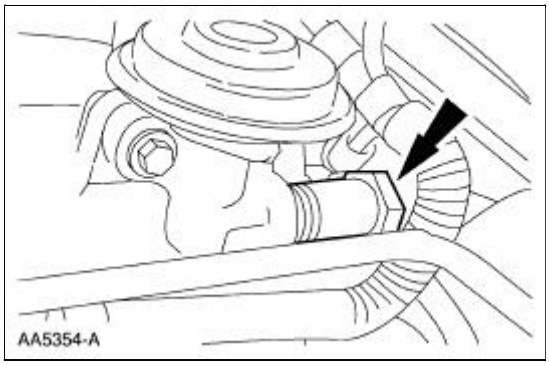
8. Disconnect the main chassis vacuum supply line and the EGR valve vacuum line.



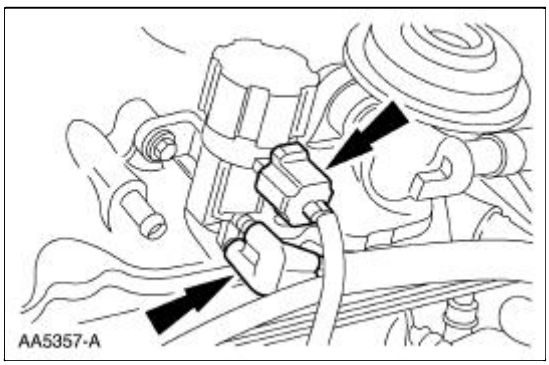
9. Disconnect the differential pressure feedback EGR hoses.



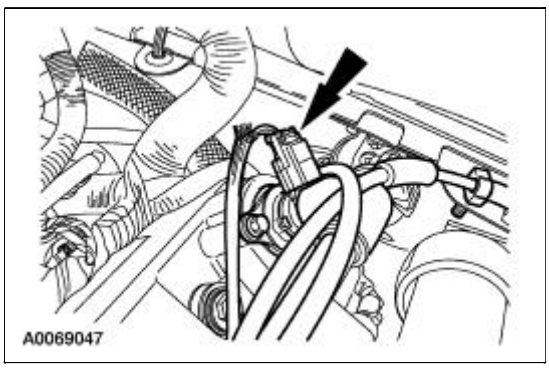
10. Disconnect the EGR valve to exhaust manifold tube from the EGR valve.



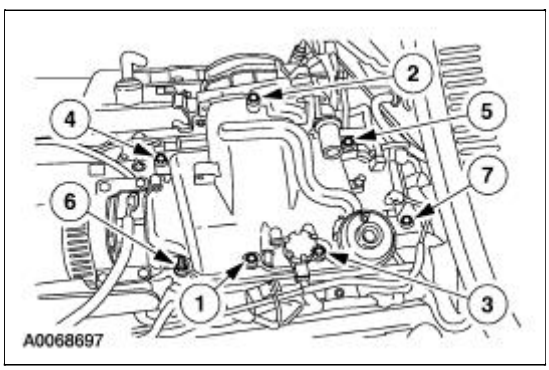
11. Disconnect the electrical connector and the vacuum lines from the EGR vacuum regulator solenoid.



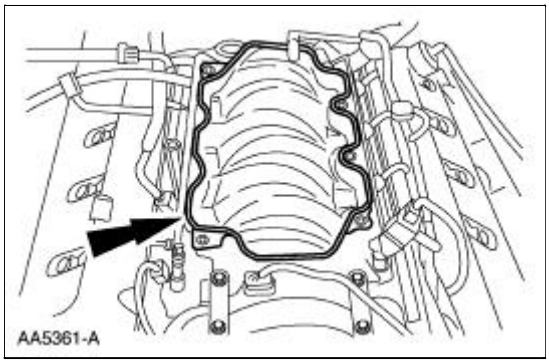
12. Remove the PCV valve-to-intake manifold tube.



13. Remove the upper intake manifold bolts in the sequence shown and remove the intake manifold assembly.

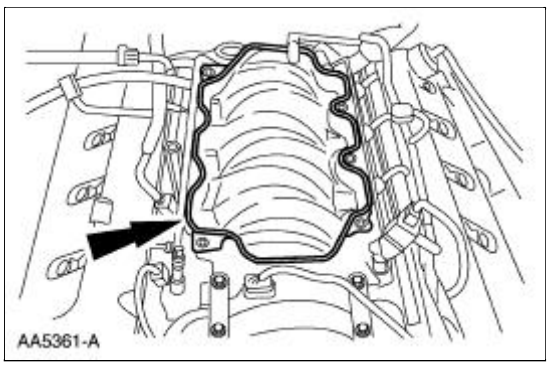


14. Inspect and clean the sealing surfaces.

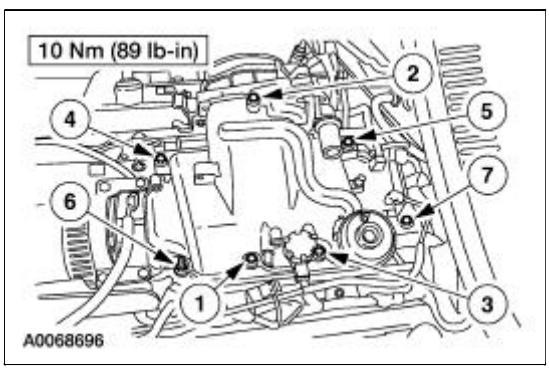


Installation

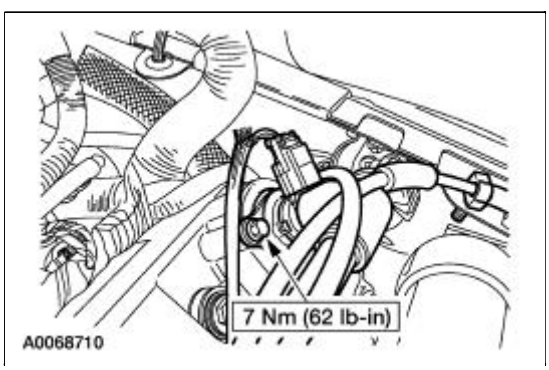
1. Install the upper intake manifold gasket.



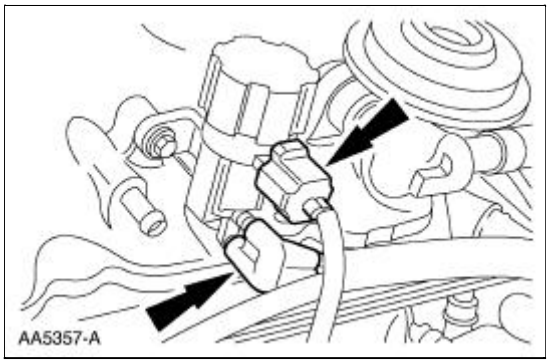
2. Install the intake manifold and bolts in the sequence shown.



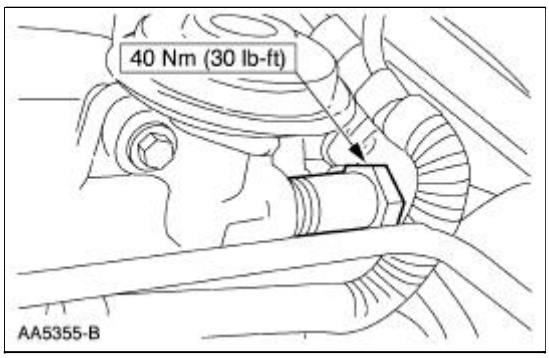
3. Install the PCV valve-to-intake manifold tube.



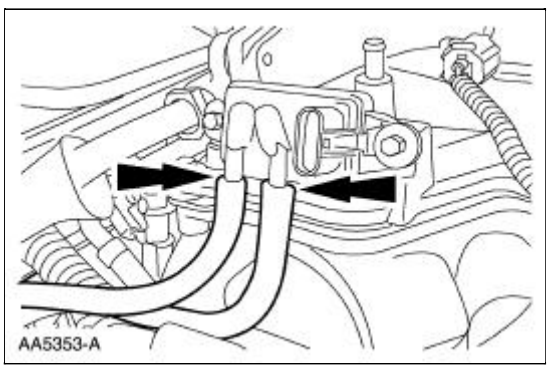
4. Connect the vacuum hoses and the electrical connector to the EGR vacuum regulator solenoid.



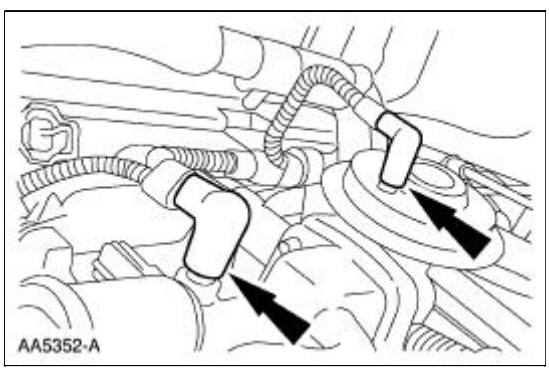
5. Connect the EGR tube to the EGR valve.



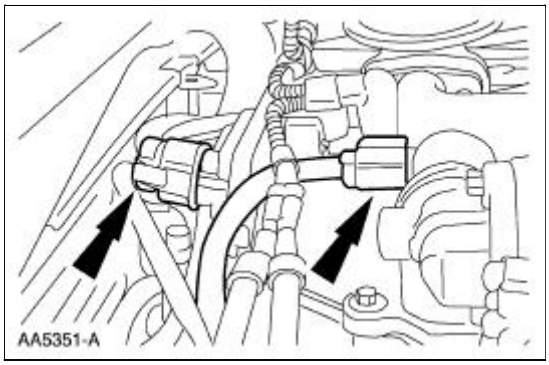
6. Connect the hoses to the differential pressure feedback EGR.



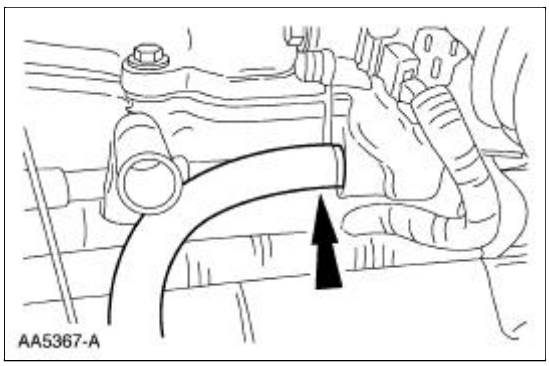
7. Connect the main chassis vacuum supply line and the EGR valve vacuum line.



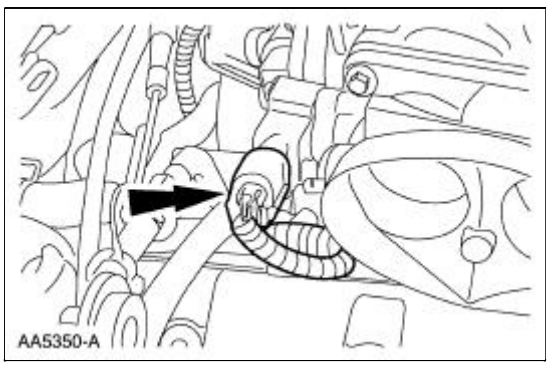
8. Connect the IAC valve and the differential pressure feedback EGR electrical connectors.



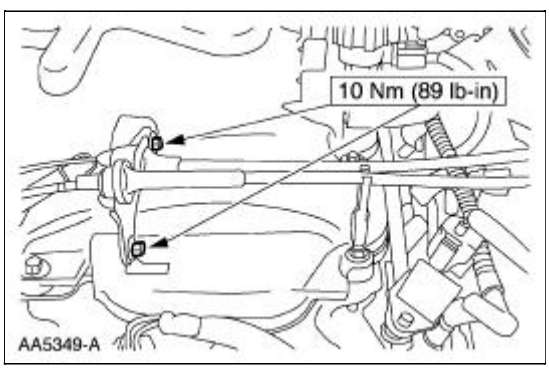
9. Connect the EVAP return hose.



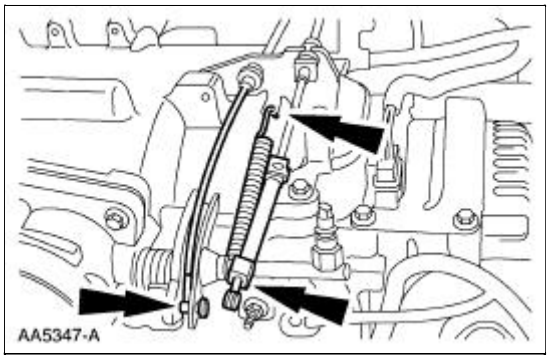
10. Connect the TP sensor.



11. Position the cables and bracket.
    - Install the bolts, connect the clip.



12. Connect the throttle cable, the speed control actuator cable and throttle return spring.



13. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .

14. Install the air intake scoop bracket. For additional information, refer to Section 303-12 .

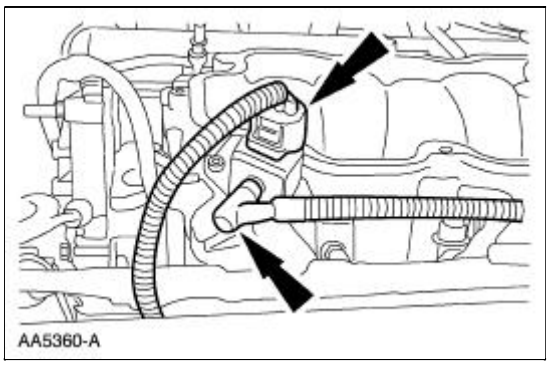
Intake Manifold —Lower

Material

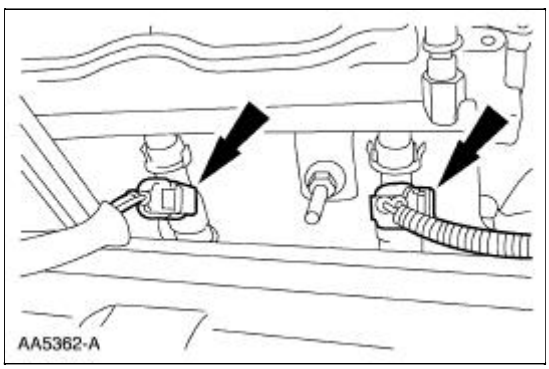
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A

Removal

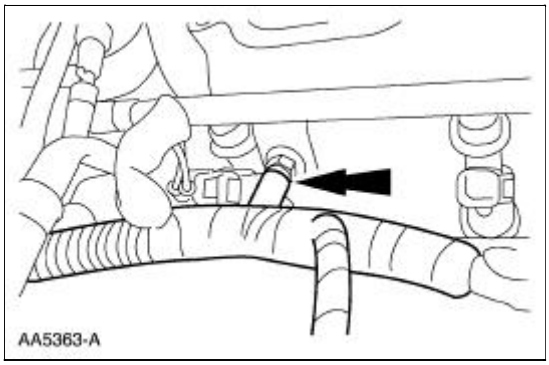
1. Remove the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.
2. Disconnect the fuel line. For additional information, refer to Section 310-00 .
3. Remove the coolant by-pass tube. For additional information, refer to Section 303-03A .
4. Remove the generator. For additional information, refer to Section 414-02 .
5. Disconnect the electrical connector and the vacuum line from the fuel pressure sensor.



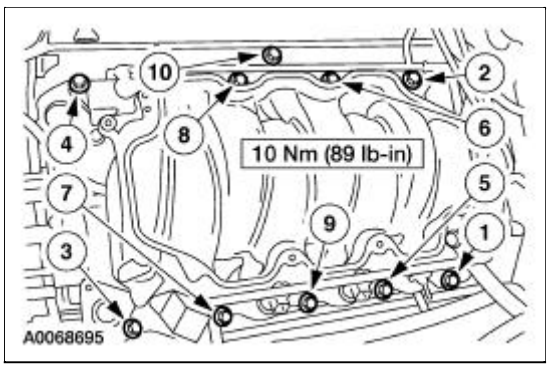
6. Disconnect the eight fuel injector electrical connectors.



7. Separate the fuel charging wiring harness from the fuel injection supply manifold studs in three places.

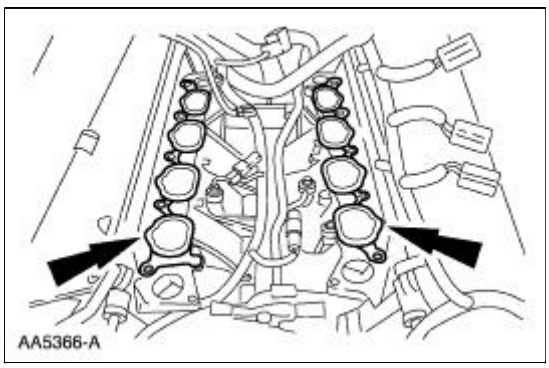


8. Remove the ten bolts in the sequence shown and raise the lower intake manifold slightly.



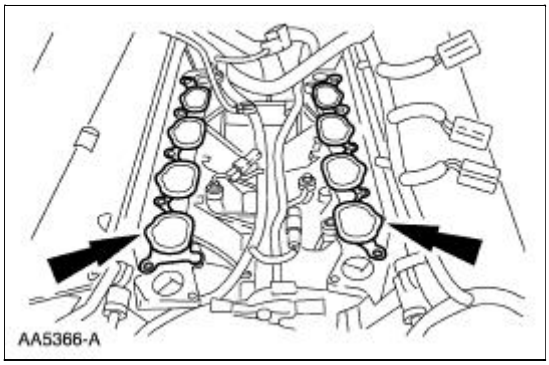
9. Disconnect the fuel charging wiring harness from the rear of the lower intake manifold and remove the manifold.

10. Remove the intake manifold gaskets.
    - Clean and inspect the sealing surfaces.



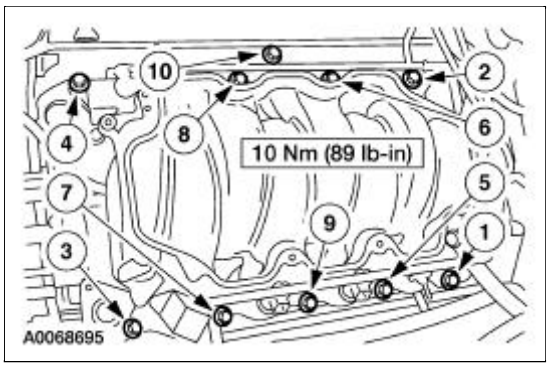
Installation

1. Install the lower intake manifold gaskets.

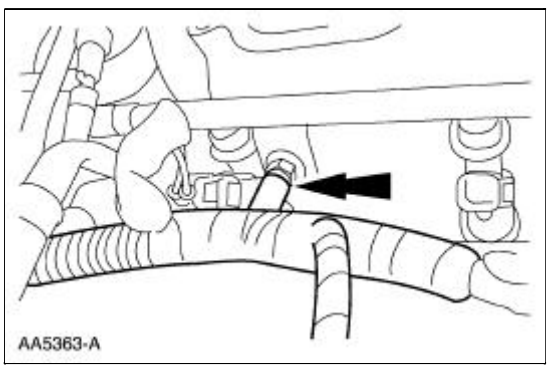


2. Connect the fuel charging wiring harness to the rear of the lower intake manifold and install the manifold.

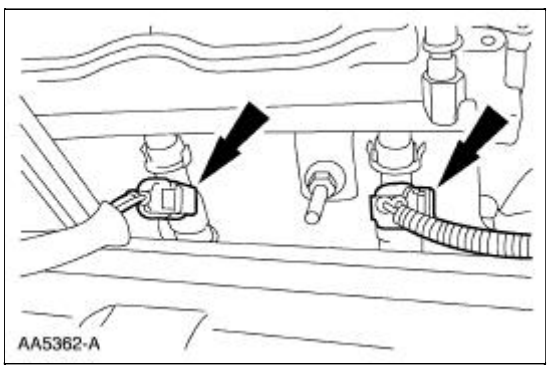
3. Install the intake manifold fasteners and tighten in the sequence shown.



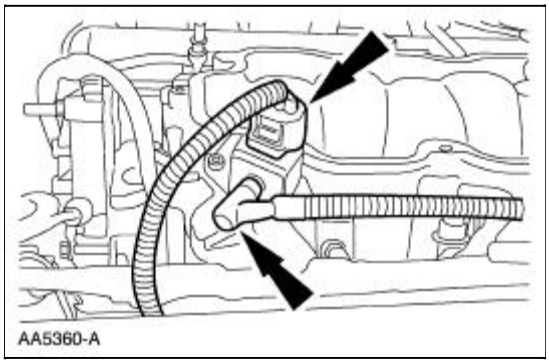
4. Position the fuel charging wiring harness and connect it to the fuel injection supply manifold in three places.



5. Connect the eight fuel injector electrical connectors.



6. Connect the electrical connector and the vacuum line to the fuel pressure sensor.



7. Install the generator. For additional information, refer to Section 414-02 .
8. Install the coolant bypass tube. For additional information, refer to Section 303-03A .
9. Connect the fuel line. For additional information, refer to Section 310-00 .
10. Install the upper intake manifold. For additional information, refer to Intake Manifold—Upper in this section.

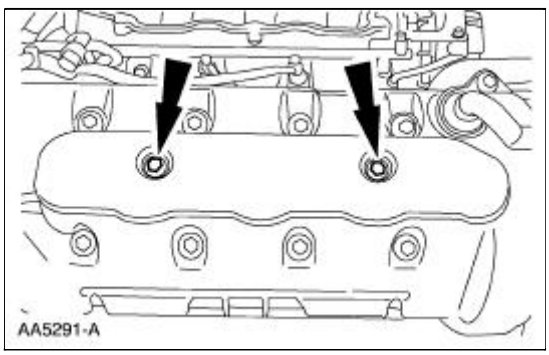
Valve Cover RH

Material

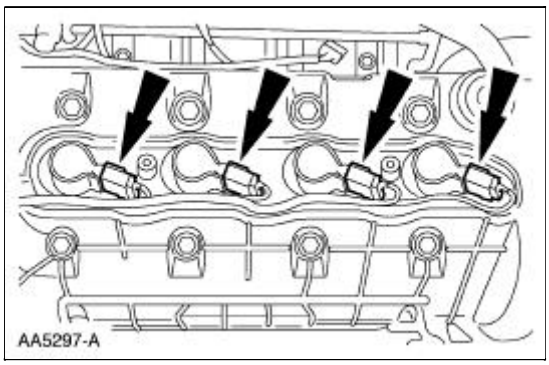
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
PAG Refrigerant Compressor Oil F7AZ-19589-DA (Motorcraft YN-12-C) or equivalent	WSH-M1C231-B

Removal

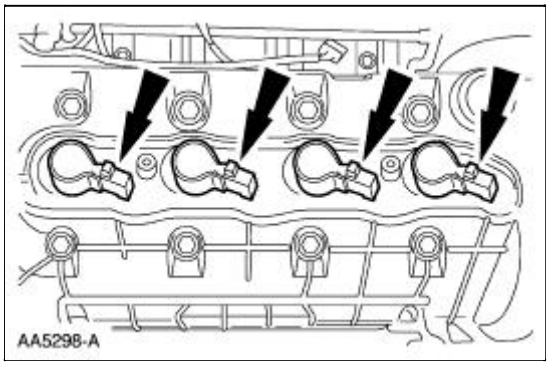
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Drain the cooling system. For additional information, refer to Section 303-03A .
3. Recover the refrigerant. For additional information, refer to Section 412-00 .
4. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
5. Remove the RH ignition coil cover bolts and the cover.



6. Disconnect the ignition coil electrical connectors.



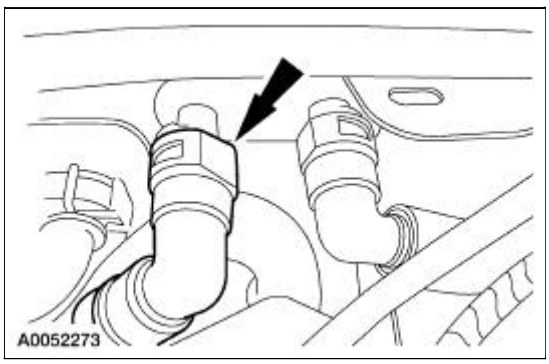
7. Remove the ignition coils.



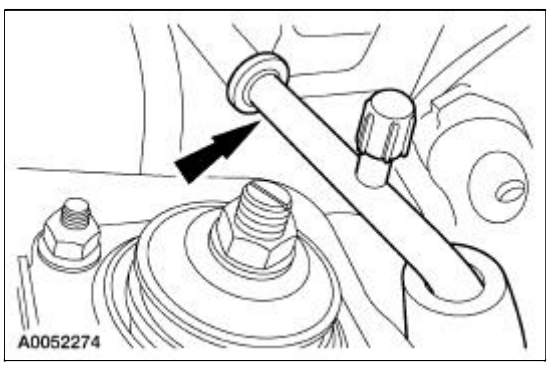
8. Remove the throttle body. For additional information, refer to Section 303-04D .

9. Disconnect the fuel tube spring lock coupling. For additional information, refer to Section 310-00 .

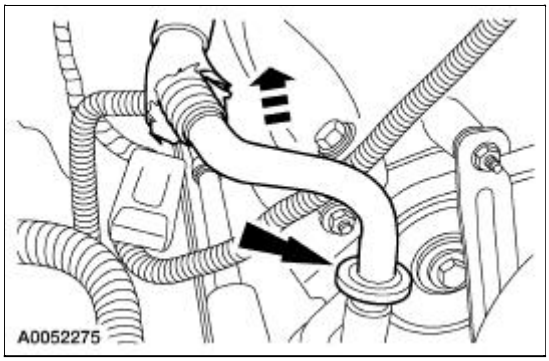
10. Disconnect the heater hose.



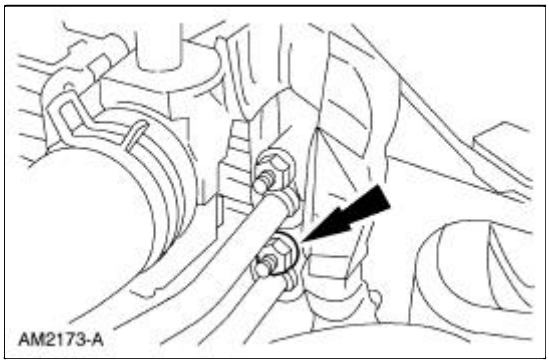
11. Disconnect the A/C suction tube at the accumulator.



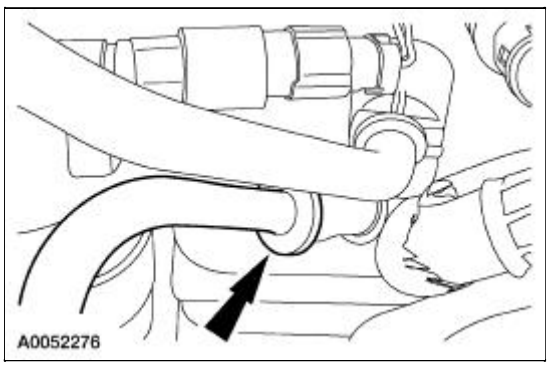
12. Disconnect and remove the A/C suction tube.



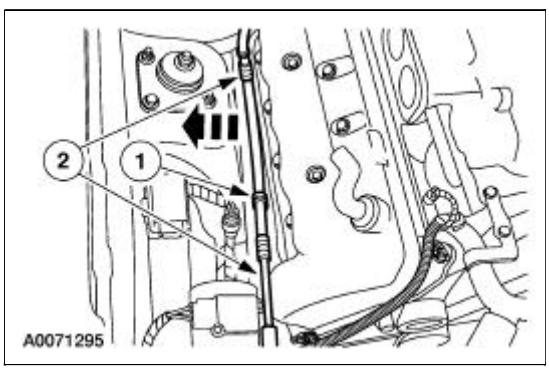
13. Remove the nut and separate the A/C tube from the condenser.



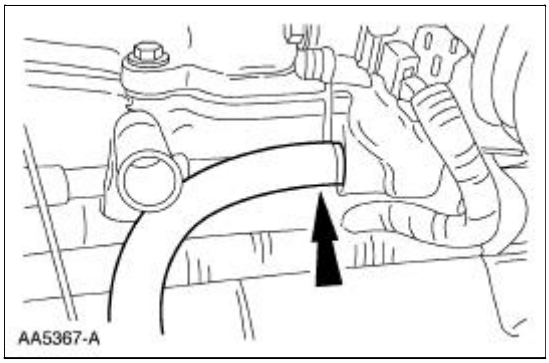
14. Disconnect the A/C tube at the evaporator.



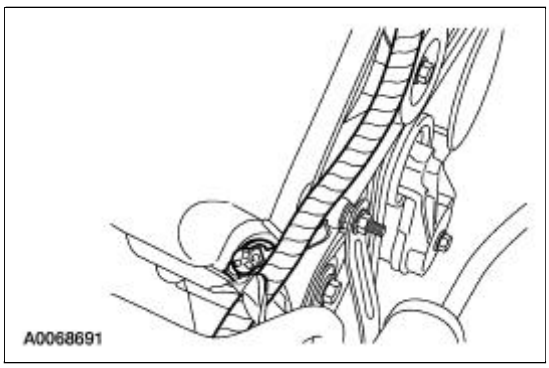
15. Remove the A/C tube.
    1. Disconnect the pin-type retainer.
    2. Remove the A/C tube.



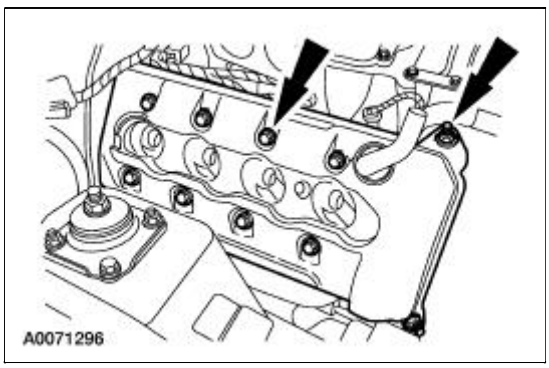
16. Disconnect the evaporative emissions (EVAP) return tube.



17. Disconnect the wiring harness from the valve cover stud bolt.

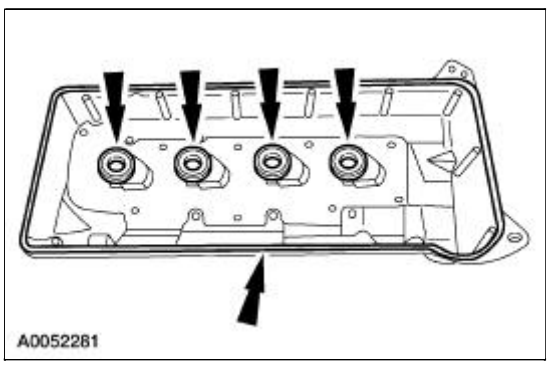


18. Remove the bolts and the RH valve cover.



19. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

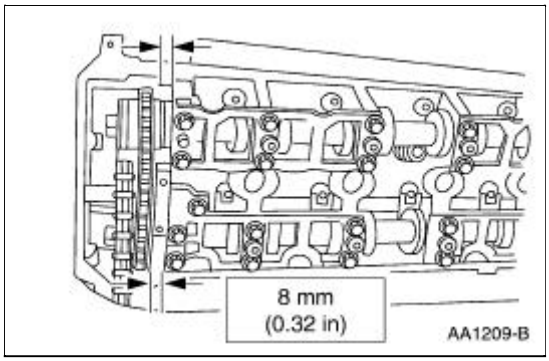
    Clean and inspect the sealing surfaces and inspect the valve cover gaskets. If necessary, install new gaskets. Make sure the gaskets are correctly seated on the valve cover.



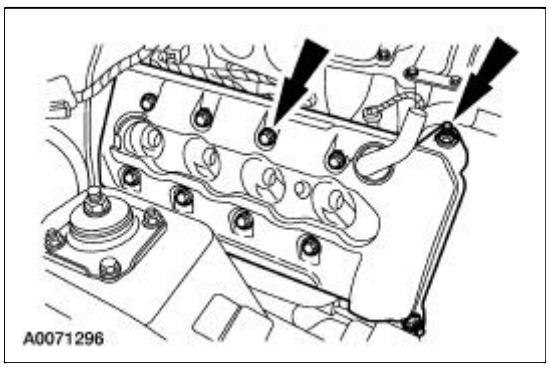
Installation

1. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

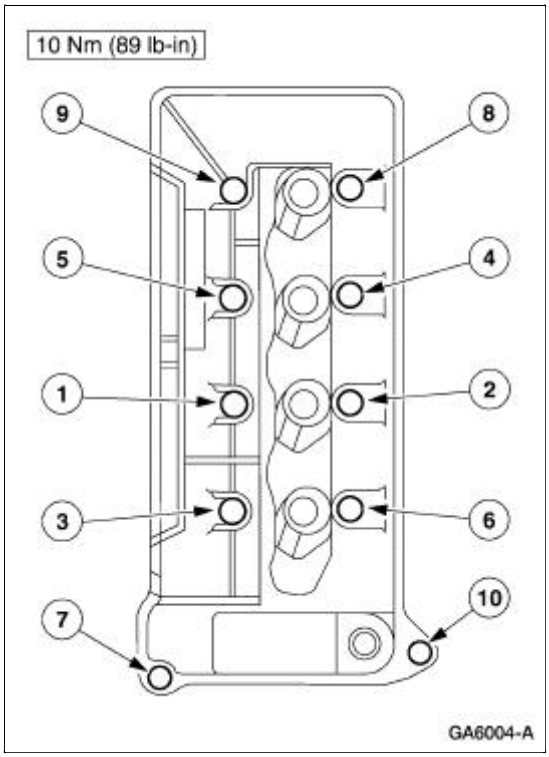
   Apply a bead of silicone gasket and sealant in two places where the engine front cover meets the cylinder head.



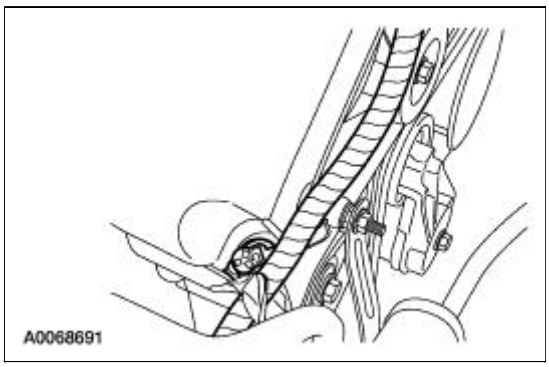
2. Install the RH valve cover and finger tighten the bolts.



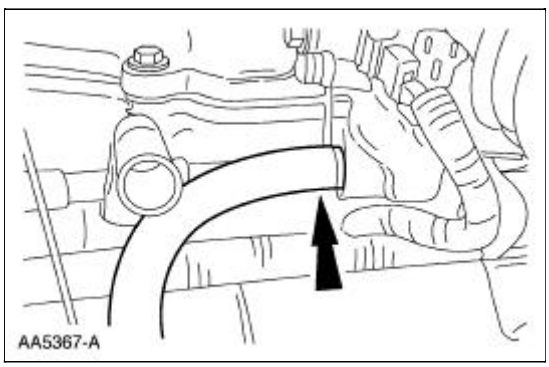
3. Tighten the RH valve cover bolts in the sequence shown.



4. Connect the wiring harness to the valve cover stud bolt.

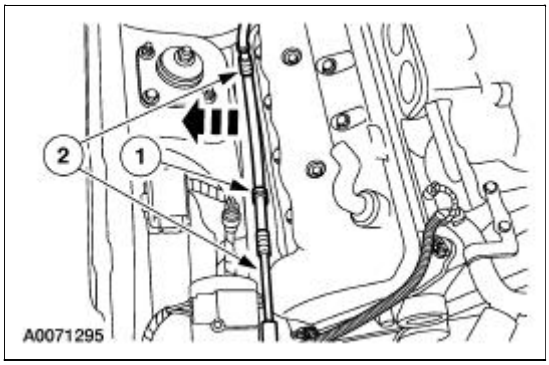


5. Connect the evaporative emissions (EVAP) return tube.



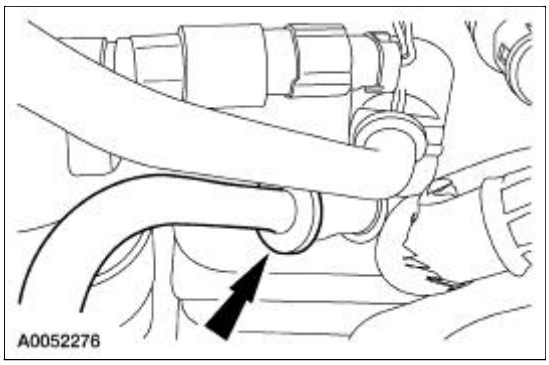
6. **NOTE:** Lubricate O-ring with clean PAG oil or equivalent.

   Install the A/C tube.
   1. Install the A/C tube.
   2. Connect the pin-type retainer.

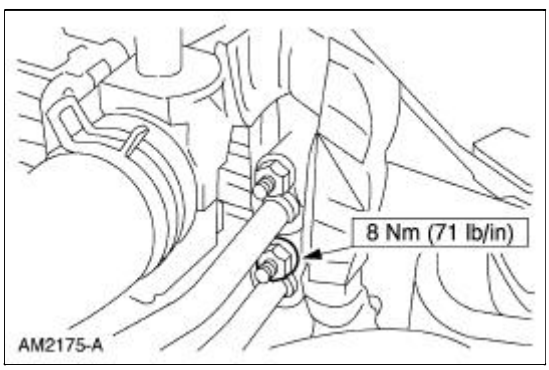


7. **NOTE:** Lubricate O-ring with clean PAG oil or equivalent.

   Connect the A/C tube to the evaporator.

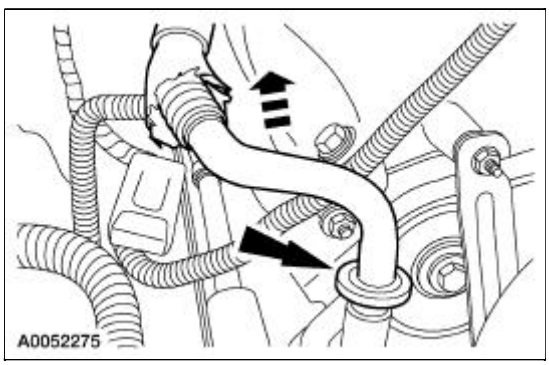


8. Connect the A/C tube and install the nut.



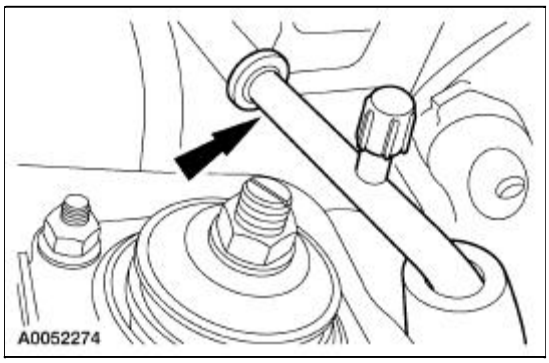
9. **NOTE:** Lubricate O-ring with clean PAG oil or equivalent.

   Install the A/C suction tube.

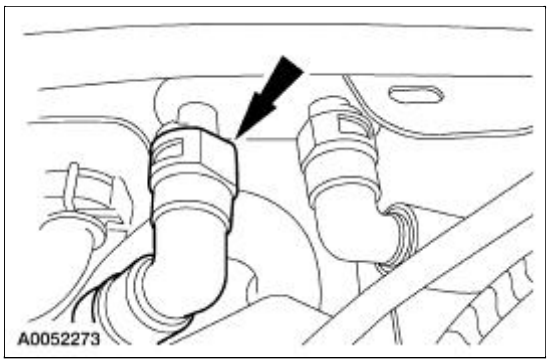


10. **NOTE:** Lubricate O-ring with clean PAG oil or equivalent.

    Connect the A/C suction tube to the accumulator.



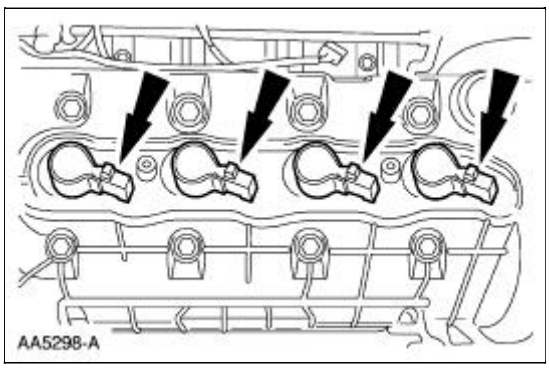
11. Connect the heater hose.



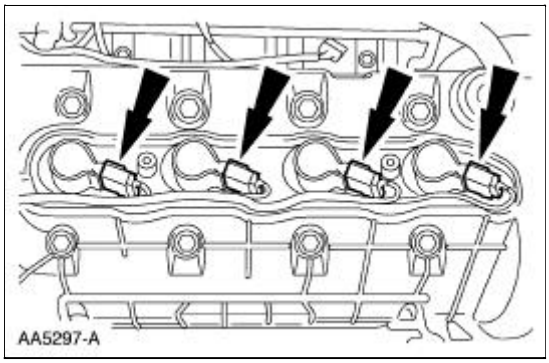
12. Install the throttle body. For additional information, refer to Section 303-04D .

13. Connect the fuel tube spring lock coupling. For additional information, refer to Section 310-00 .

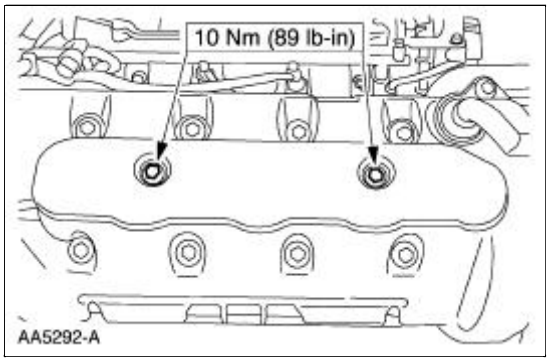
14. Install the RH ignition coils.



15. Connect the RH ignition coil electrical connectors.



16. Install the RH ignition coil cover and the two bolts.



17. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .
18. Connect the battery ground cable. For additional information, refer to Section 414-01 .
19. Fill the cooling system. For additional information, refer to Section 303-03A .
20. Recharge the A/C system. For additional information, refer to Section 412-00 .

Valve Cover LH

Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4

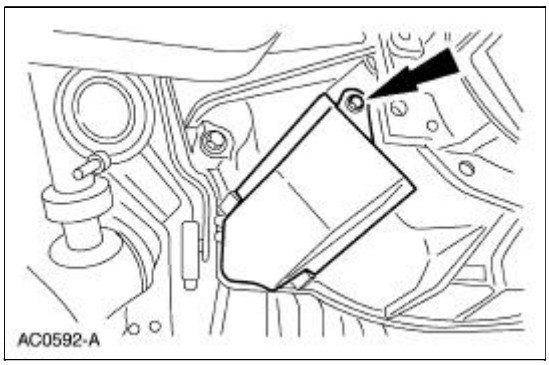
Removal

All vehicles

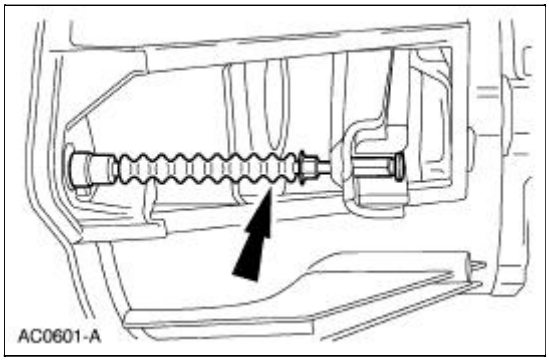
1. Remove the air intake scoop. For additional information, refer to Section 303-12 .
2. Remove the Hydro-Boost brake booster. For additional information, refer to Section 206-07 .
3. Raise and support the vehicle. For additional information, refer to Section 100-02 .

Manual transmission vehicles

4. Remove the screw and the dust shield.

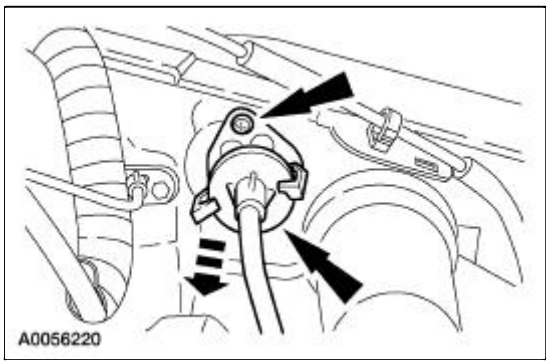


5. Disengage the clutch release cable from the clutch release fork.



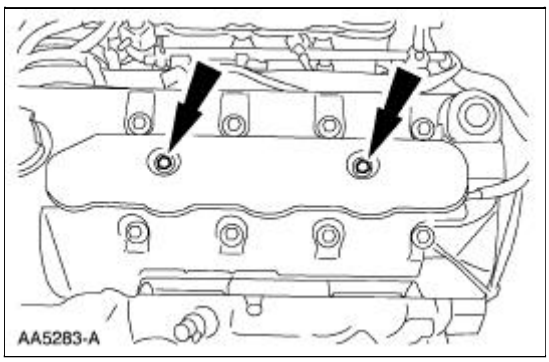
6. Lower the vehicle.

7. Remove the two screws and position the clutch release cable aside.

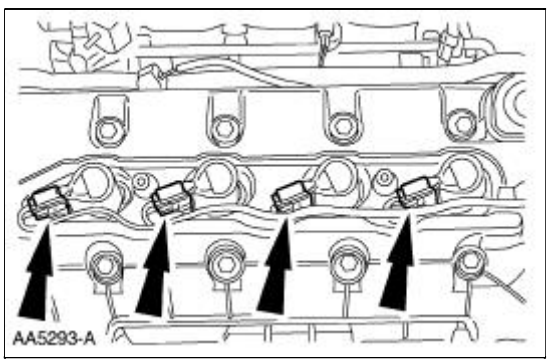


All vehicles

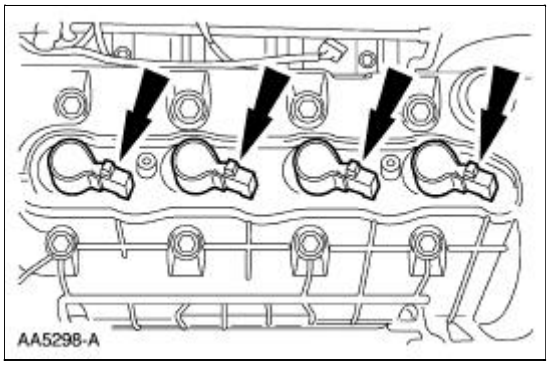
8. Remove the LH ignition coil cover bolts and the cover.



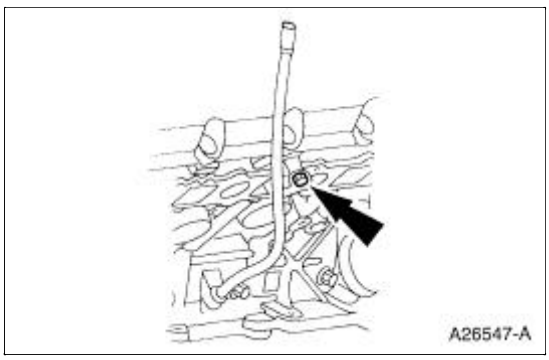
9. Disconnect the ignition coil electrical connectors.



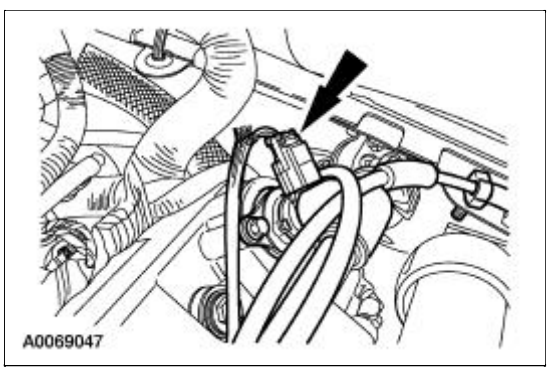
10. Remove the ignition coils.



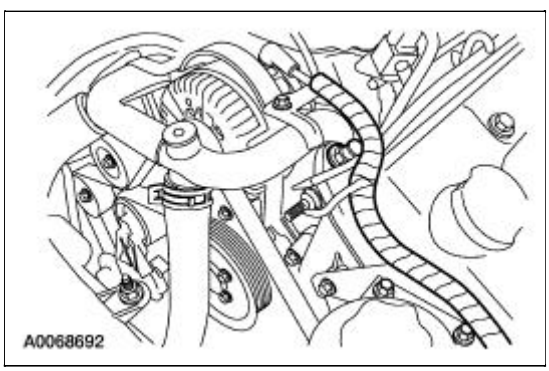
11. Remove the bolt and position the oil level indicator tube aside.



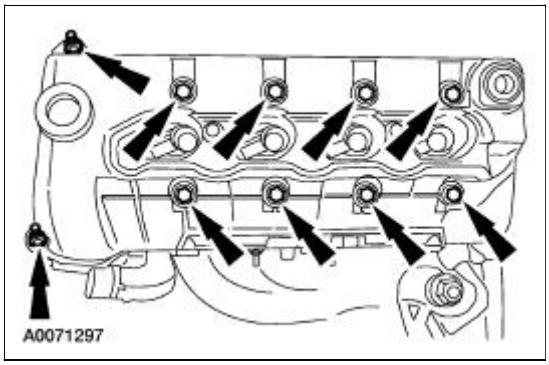
12. Disconnect the positive crankcase ventilation (PCV) valve hose and the electrical connector.



13. Disconnect the wiring harness anchor from the valve cover.

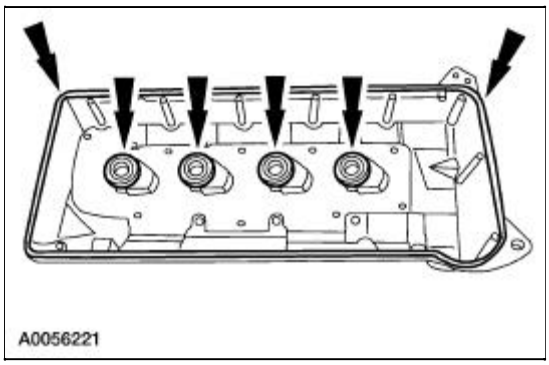


14. Remove the LH valve cover.



15. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

    Clean and inspect the sealing surfaces and the valve cover gaskets. If necessary, install new gaskets. Make sure the gaskets are correctly seated on the valve cover.

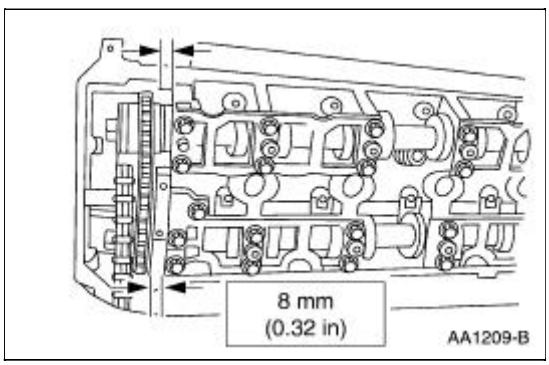


Installation

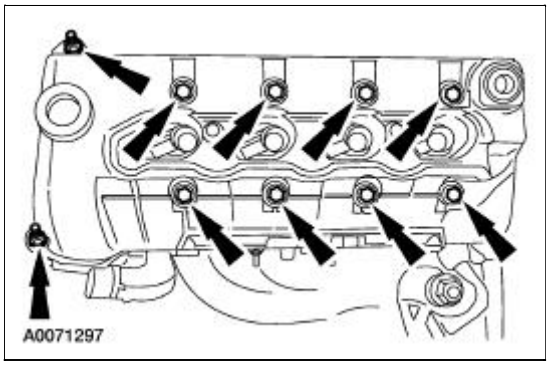
All vehicles

1. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

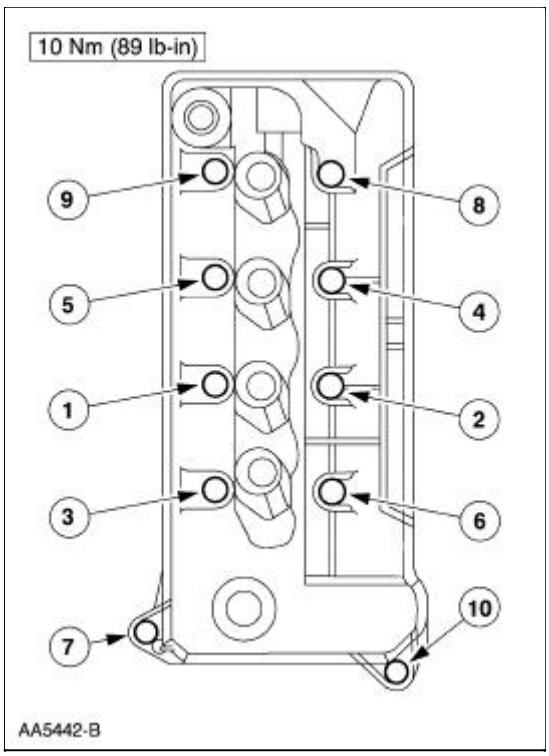
   Apply silicone gasket and sealant to areas shown.



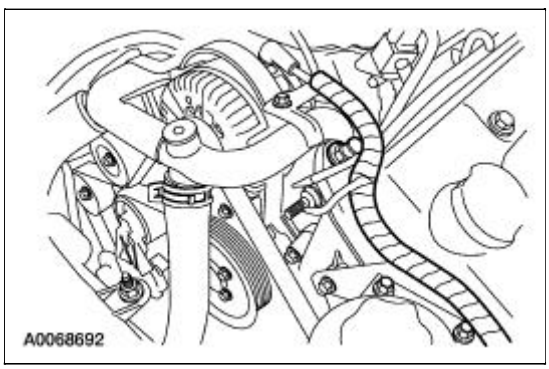
2. Install the LH valve cover and loosely install the bolts.



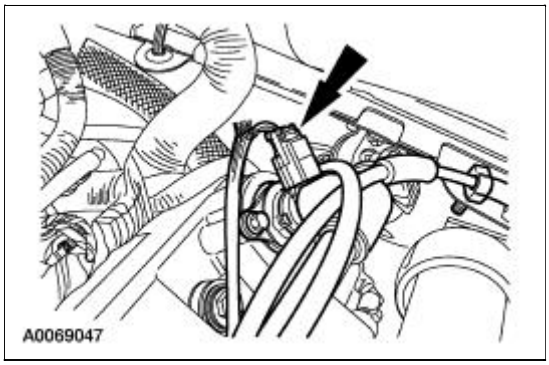
3. Tighten the LH valve cover bolts in the sequence shown.



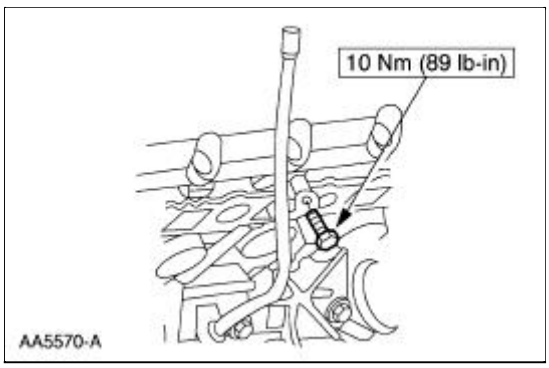
4. Connect the wiring harness anchor to the valve cover stud bolt.



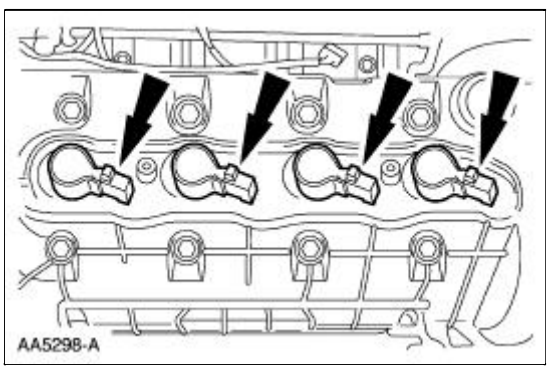
5. Connect the positive crankcase ventilation (PCV) valve hose and electrical connector.



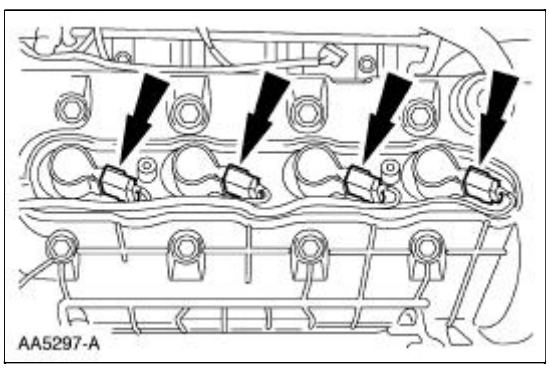
6. Position the oil level indicator tube and install the bolt.



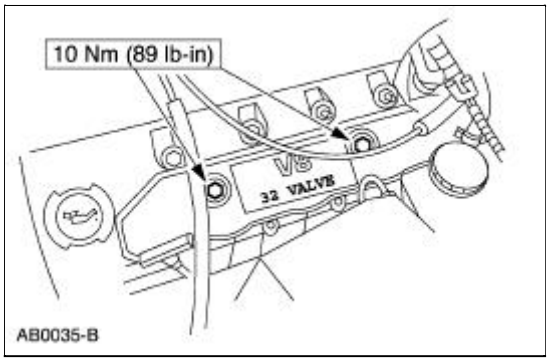
7. Install the LH ignition coils.



8. Connect the ignition coil electrical connectors.

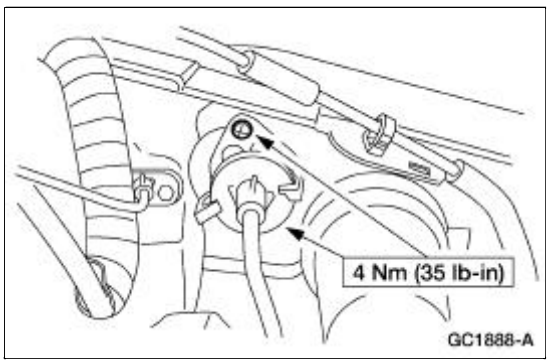


9. Install the LH ignition coil cover and the bolts.



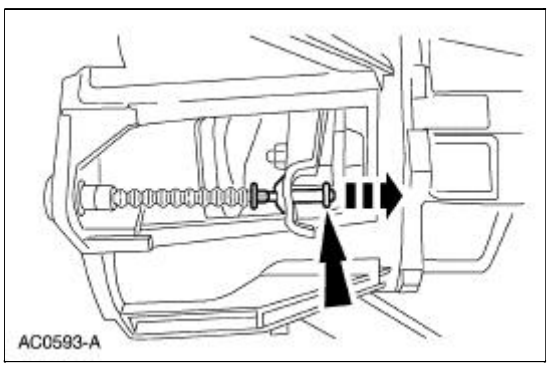
Manual transmission vehicles

10. Install the clutch release cable and install the two screws.

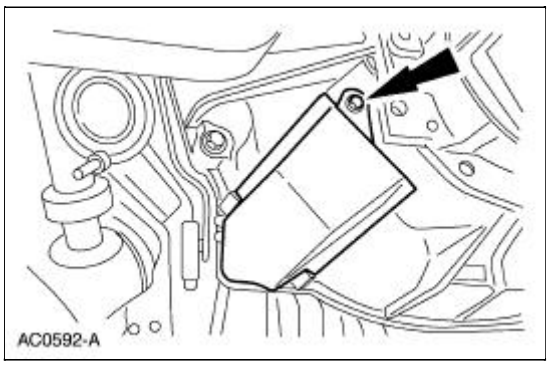


11. Raise and support the vehicle. For additional information, refer to Section 100-02 .

12. Connect the clutch release cable to the clutch release fork.



13. Install the dust shield and the screw.



14. Lower the vehicle.

All vehicles

15. Install the Hydro-Boost brake booster. For additional information, refer to Section 206-07 .
16. Install the air intake scoop. For additional information, refer to Section 303-12 .

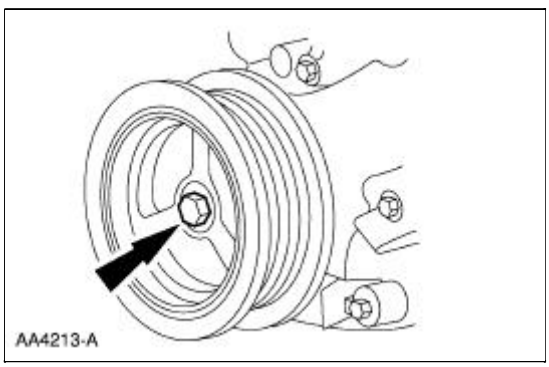
Crankshaft Pulley

Special Tool(s)

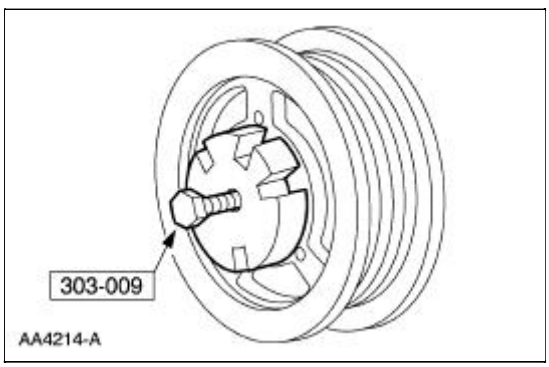
ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)

Removal

1. Remove the accessory drive belt. For additional information, refer to Section 303-05 .
2. Raise and support the vehicle. For additional information, refer to Section 100-02 .
3. Remove the bolt.



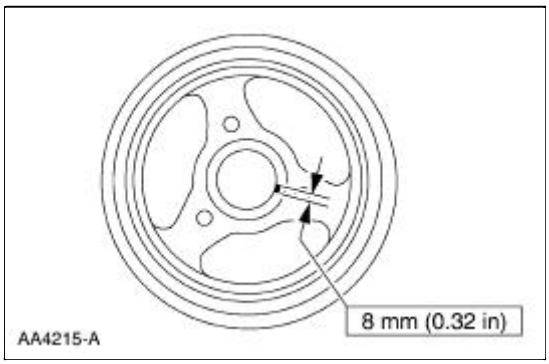
4. Using the special tool, remove the crankshaft pulley.



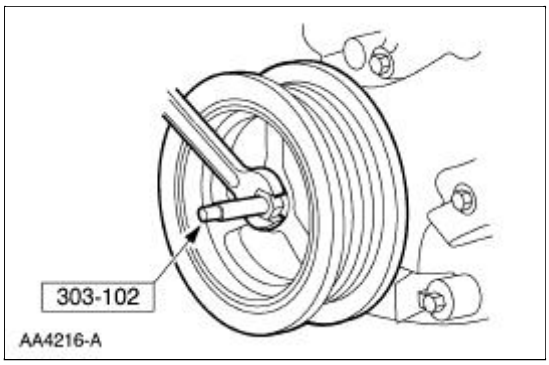
Installation

1. **NOTE:** The crankshaft pulley must be installed within four minutes after applying the silicone.

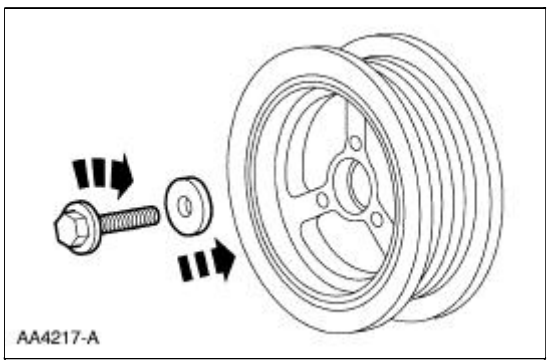
   Apply silicone to the Woodruff key slot on the crankshaft pulley.
   - Use Silicone Gasket and Sealant F7AZ-19554-EA or equivalent meeting Ford specification WSE-M4G323-A4.



2. Using the special tool, install the crankshaft pulley.



3. Install the bolt and washer. Tighten the bolt in four stages.
   - Stage 1: Tighten the bolt to 90 Nm (66 lb-ft).
   - Stage 2: Loosen the bolt one full turn.
   - Stage 3: Tighten the bolt to 50 Nm (37 lb-ft).
   - Stage 4: Tighten the bolt an additional 90 degrees.



4. Lower the vehicle.

5. Install the accessory drive belt. For additional information, refer to Section 303-05 .

Crankshaft Front Oil Seal

Special Tool(s)

ST1328-A	Crankshaft Seal Installer/Aligner 303-335 (T88T-6701-A)
ST1288-A	Front Cover Seal Remover 303-107 (T74P-6700-A)
ST2197-A	Crankshaft Seal Installer 303-635
ST1287-A	Crankshaft Damper Replacer 303-102 (T74P-6316-B)

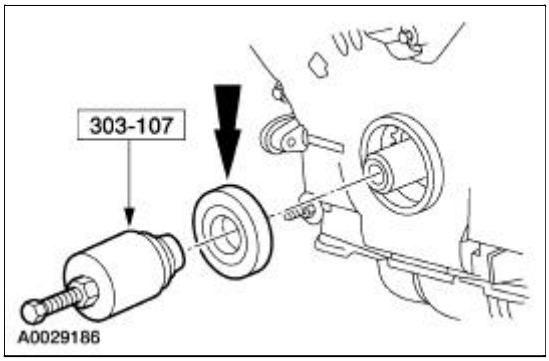
Material

Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

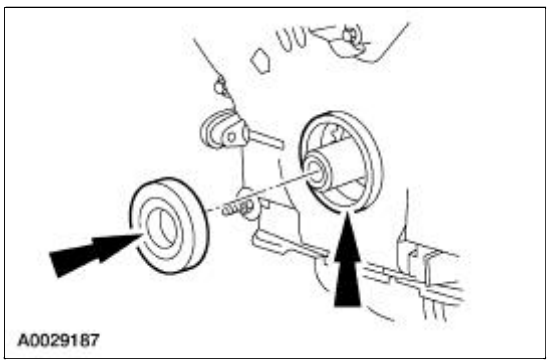
1. Remove the crankshaft pulley. For additional information, refer to Crankshaft Pulley in this section.

2. Using the special tool, remove the crankshaft front oil seal.

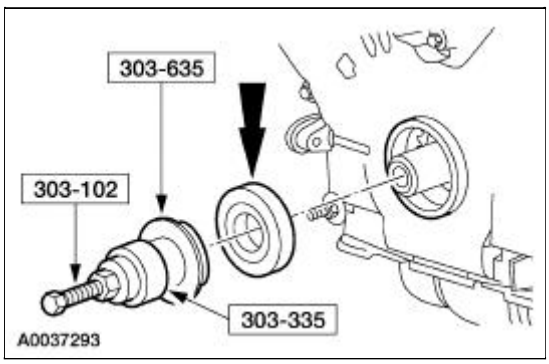


Installation

1. Lubricate the engine front cover and the crankshaft front oil seal inner lip with clean engine oil.



2. Using the special tools, install the crankshaft front oil seal into the engine front cover.



3. Install the crankshaft pulley. For additional information, refer to Crankshaft Pulley .

Engine Front Cover

Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
SAE 5W-30 Premium Synthetic Blend Motor Oil XO-5W30-QSP or equivalent	WSS-M2C153-G

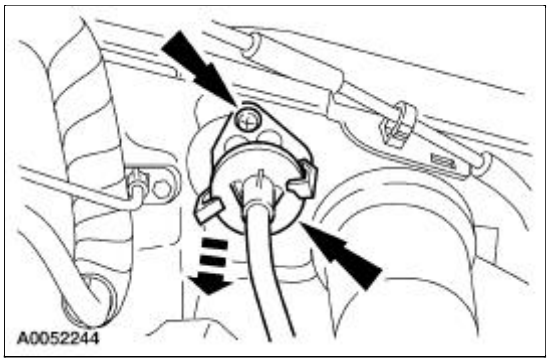
Removal

All vehicles

1. Remove the air intake scoop bracket. For additional information, refer to Section 303-12 .
2. Remove the RH valve cover. For additional information, refer to Valve Cover RH in this section.
3. Remove the Hydro-Boost brake booster. For additional information, refer to Section 206-07 .

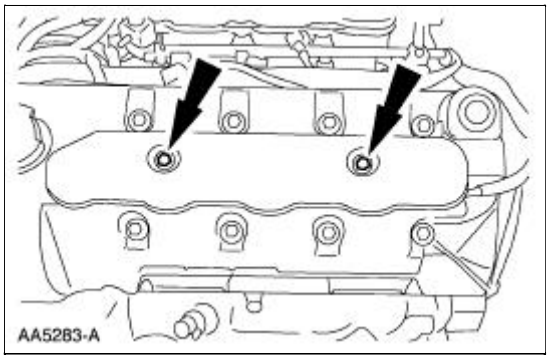
Manual transmission vehicles

4. Remove the two clutch release cable retaining screws.

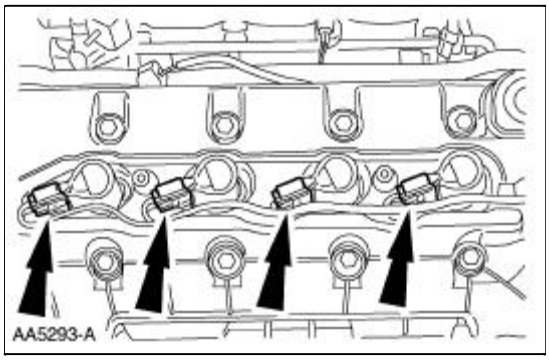


All vehicles

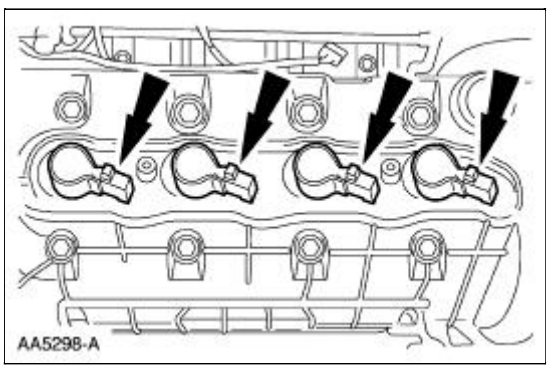
5. Remove the LH ignition coil cover bolts and the cover.



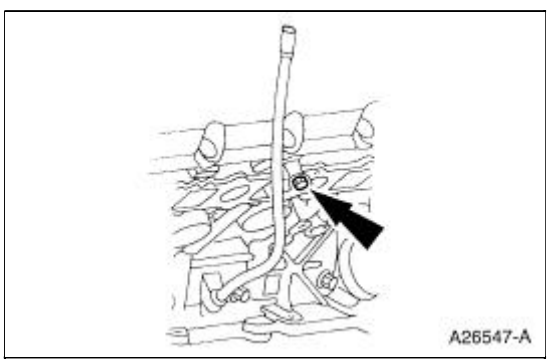
6. Disconnect the ignition coil electrical connectors.



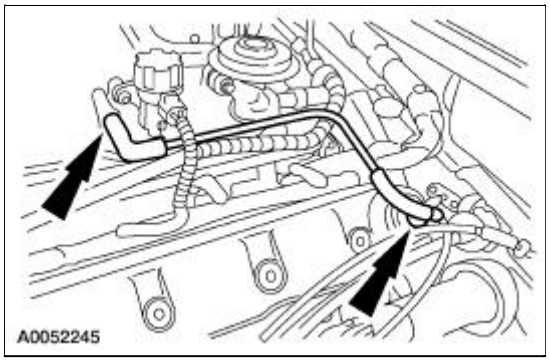
7. Remove the ignition coils.



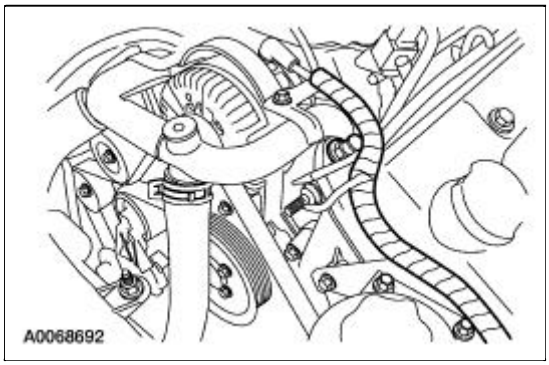
8. Remove the bolt and position the oil level indicator tube aside.



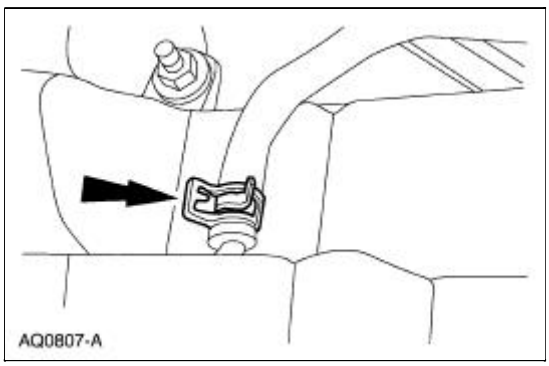
9. Remove the positive crankcase ventilation (PCV) valve hose and disconnect the electrical connector.



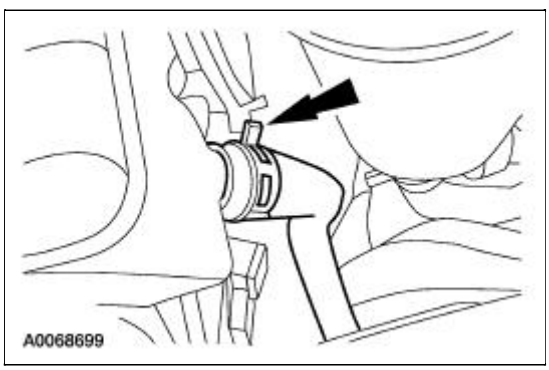
10. Disconnect the wiring harness anchor from the valve cover.



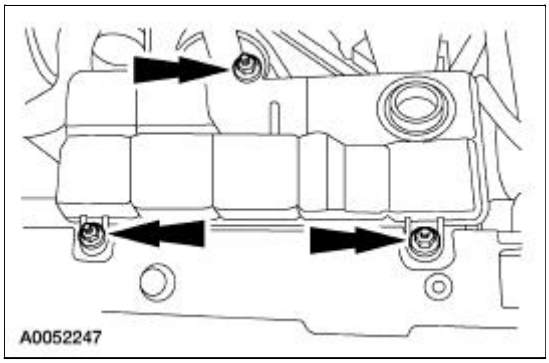
11. Remove the degas bottle vent hose.



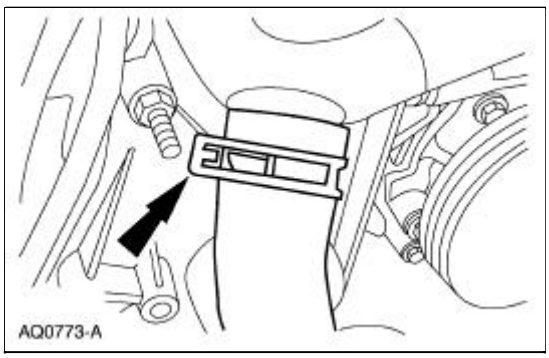
12. Remove the degas bottle return hose.



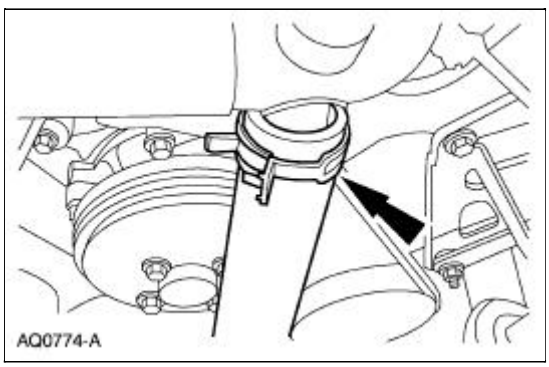
13. Remove the nuts and the degas bottle.



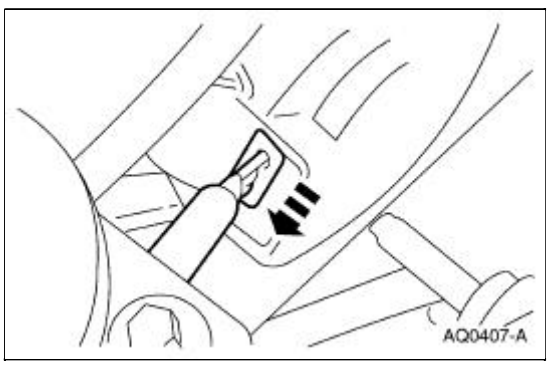
14. Disconnect the upper radiator hose from the bypass tube.



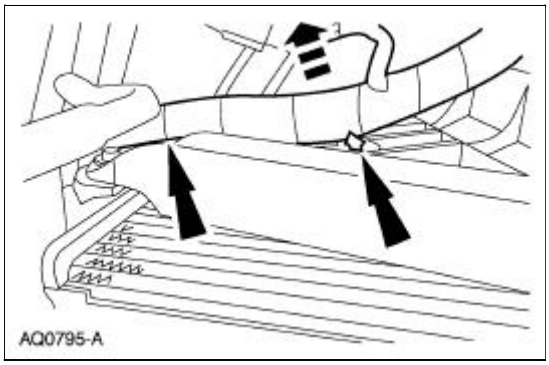
15. Disconnect the lower radiator hose from the bypass tube.



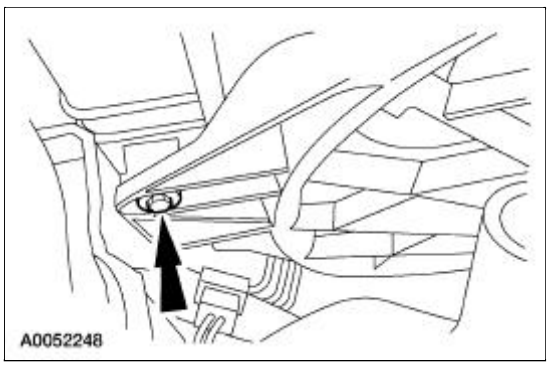
16. Disconnect the cooling fan electrical connector.



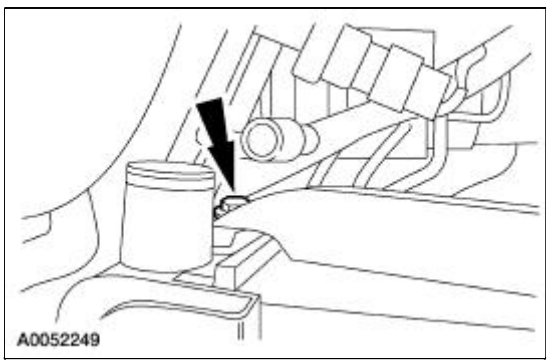
17. Separate the cooling fan wiring harness from the fan shroud.



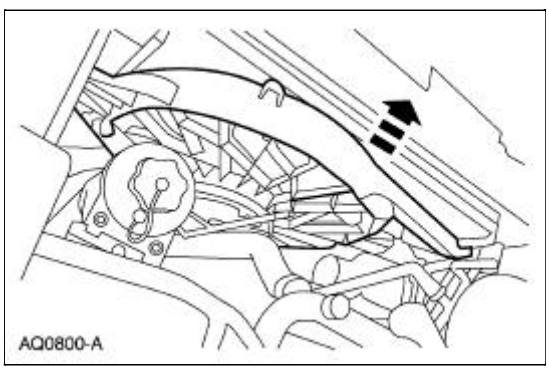
18. Remove the LH cooling fan shroud bolt.



19. Remove the RH cooling fan shroud bolt.



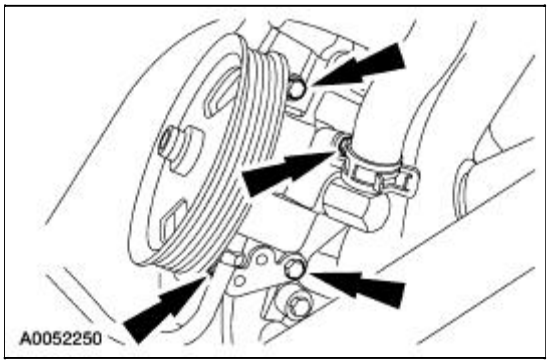
20. Remove the cooling fan and shroud as an assembly.



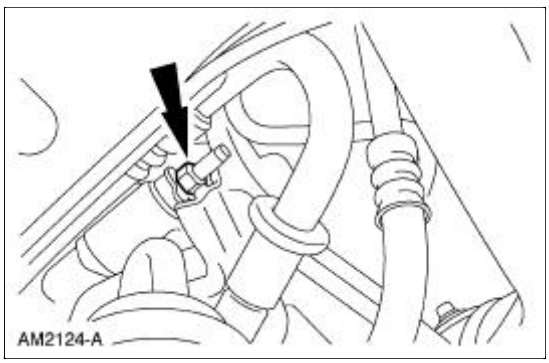
21. Remove the crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal .

22. Remove the three bolts shown. Loosen the fourth bolt (hidden behind the p/s tube). Position the

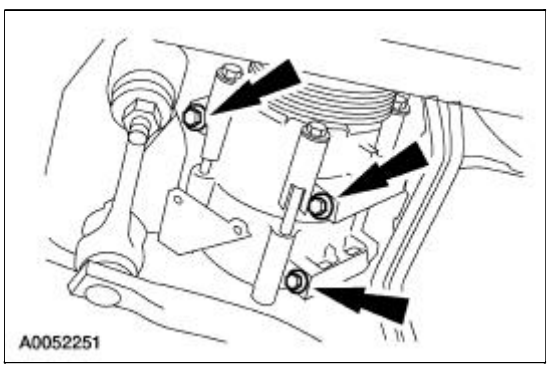
power steering pump aside.



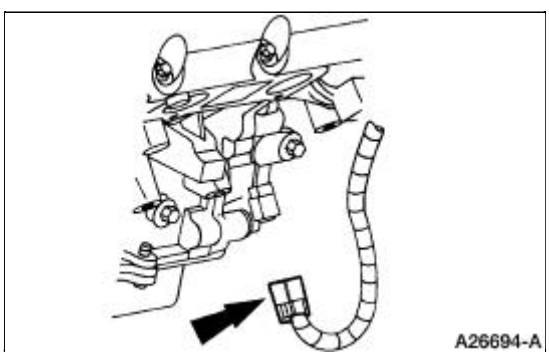
23. Remove the A/C muffler bracket nut.



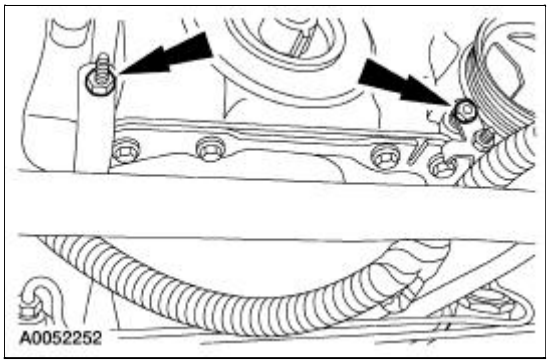
24. Remove the bolts and position the A/C compressor aside.



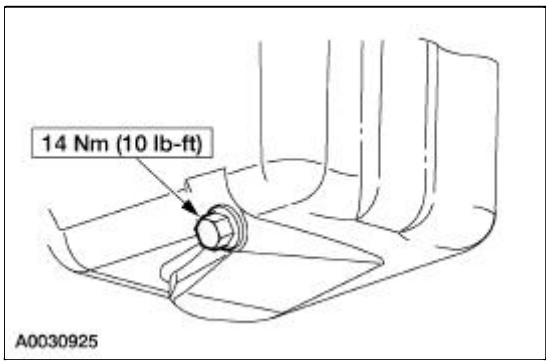
25. Disconnect the crankshaft position (CKP) sensor electrical connector.



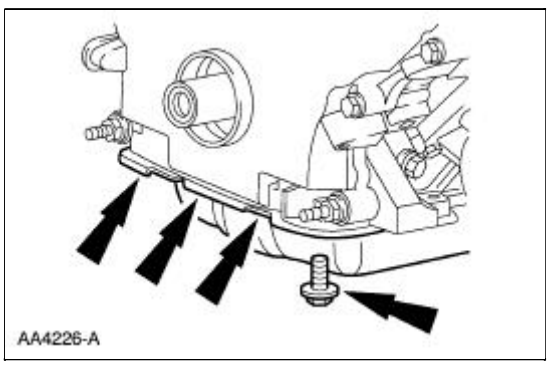
26. Remove the wiring harness nuts and position the wiring harness aside.



27. Remove the drain plug and drain the oil.
    - Install the drain plug when finished.

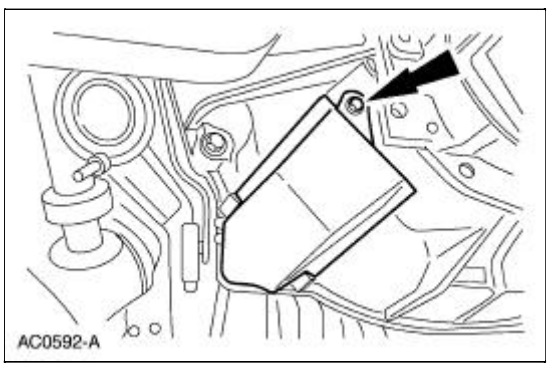


28. Remove the front four oil pan bolts.

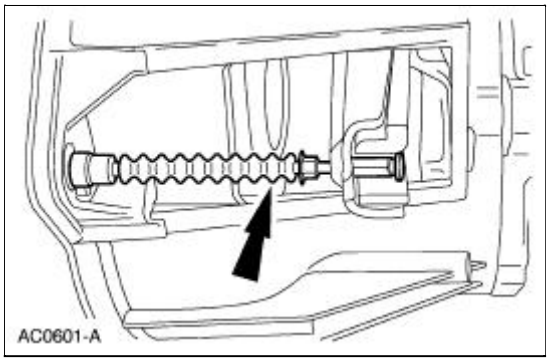


Manual transmission vehicles

29. Remove the bolt and the clutch release cable shield.



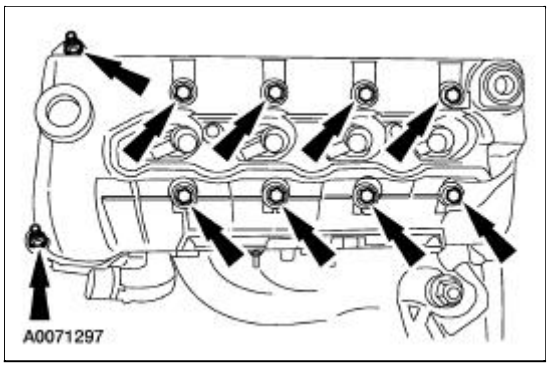
30. Disengage the clutch release cable from the clutch release fork.



31. Lower the vehicle.

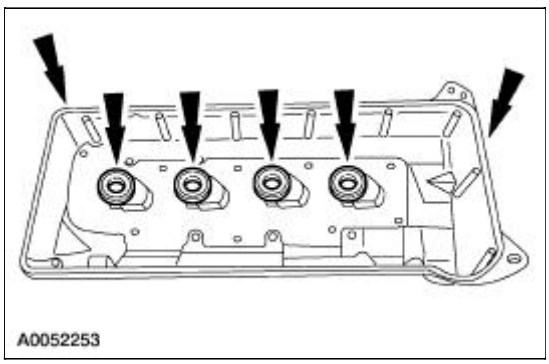
All vehicles

32. Remove the LH valve cover.

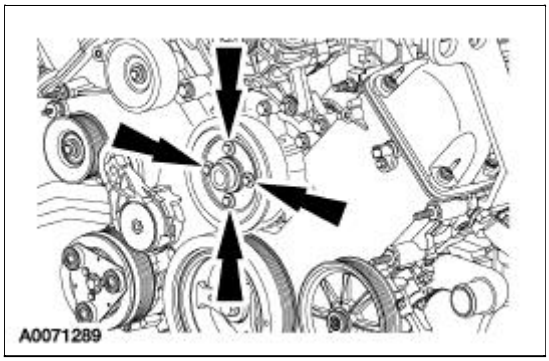


33. **CAUTION: Do not use metal scraper, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

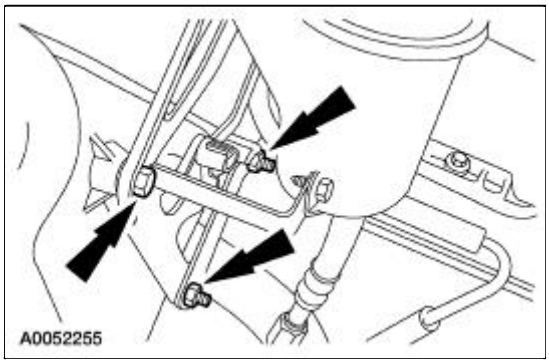
    Clean and inspect sealing surfaces and valve cover gaskets. If necessary, install new gaskets. Make sure the gaskets are correctly seated on the valve cover.



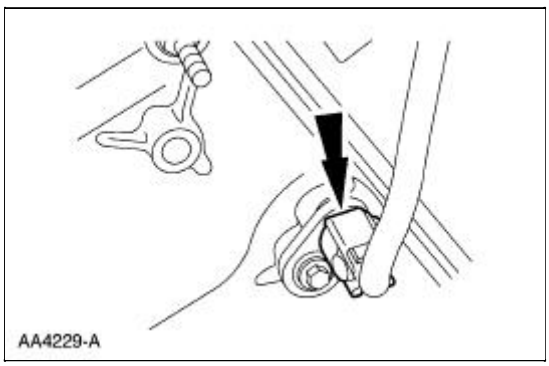
34. Remove the four bolts and the coolant pump pulley.



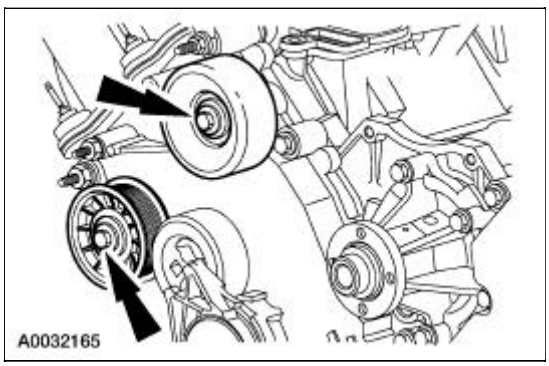
35. Remove the three bolts and position the power steering reservoir and bracket assembly aside.



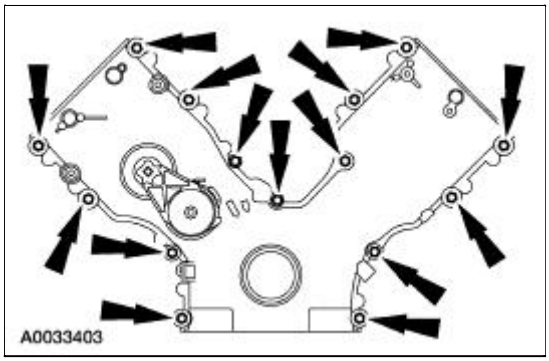
36. Disconnect the camshaft position (CMP) sensor electrical connector.



37. Remove the idler pulleys.

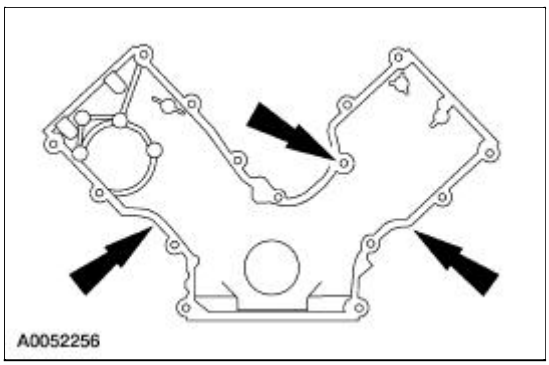


38. Remove the bolts and the studs and remove the engine front cover.



39. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

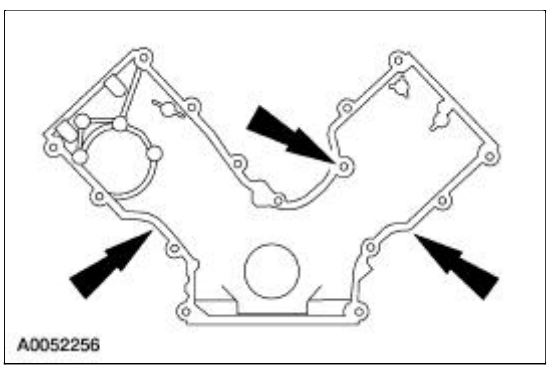
    Remove and discard the gasket. Clean and inspect the sealing surfaces.



Installation

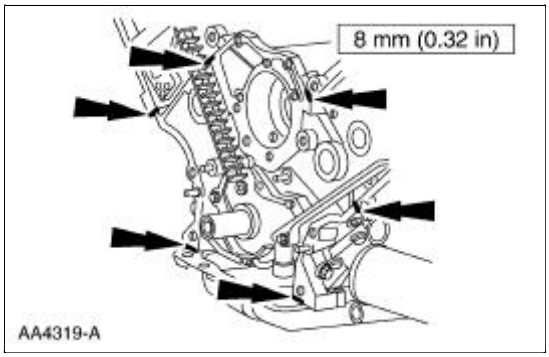
All vehicles

1. Position the engine front cover gasket on the engine front cover.

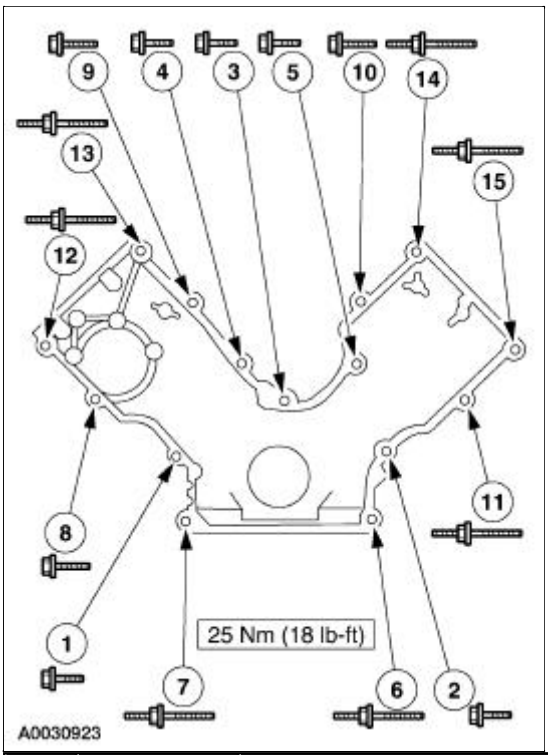


2. **NOTE:** If the engine front cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can cause future oil leakage.

   Apply the silicone gasket and sealant along the cylinder head-to-cylinder block surface and the oil pan-to-cylinder block surface.



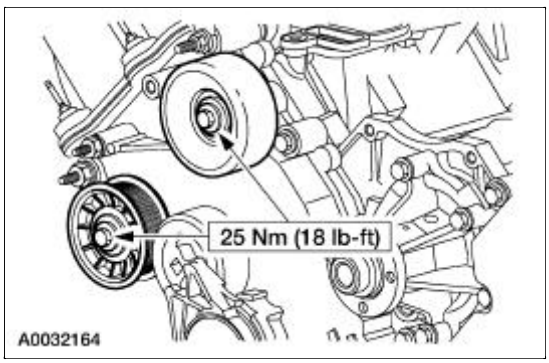
3. Install the engine front cover and tighten the bolts and studs in sequence shown.



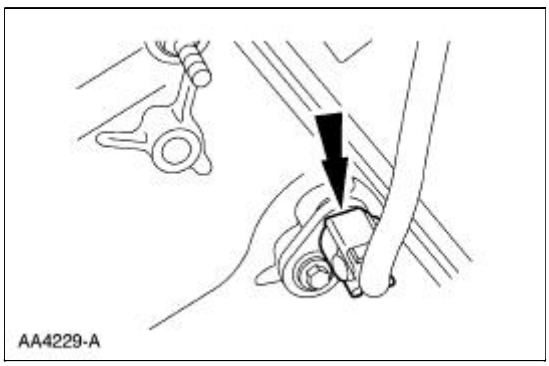
Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	W706508	Stud, Hex Shldr Pilot, M8 x 1.25 x 50 — M6 x 1 x 10
7	N808586	Stud and Washer, Hex-Head Pilot, M8 x 1.25 x 60 — M6 x 1 x 26
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
12	W706560	Stud, Hex Head Pilot, M8 x 1.25 x 65 — M8 x

		1.25 x 16
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26

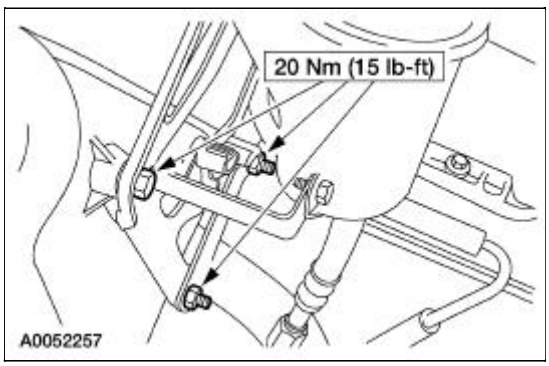
4. Install the idler pulleys.



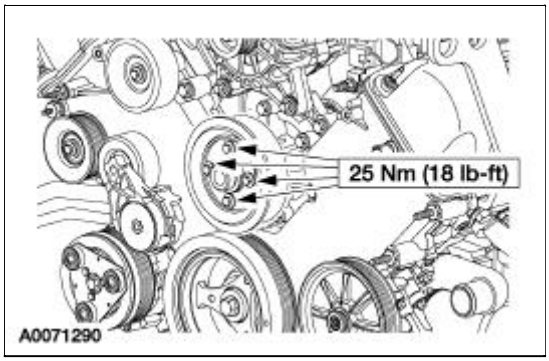
5. Connect the camshaft position (CMP) sensor electrical connector.



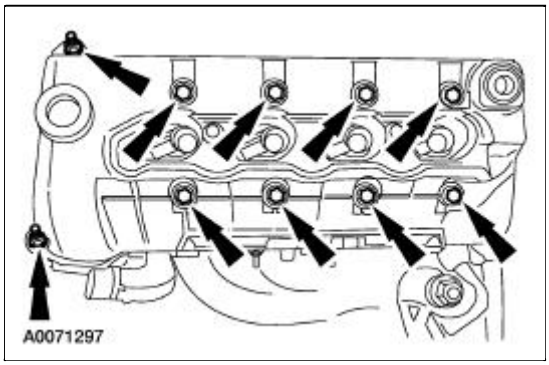
6. Position the power steering reservoir and bracket assembly and install the bolts.



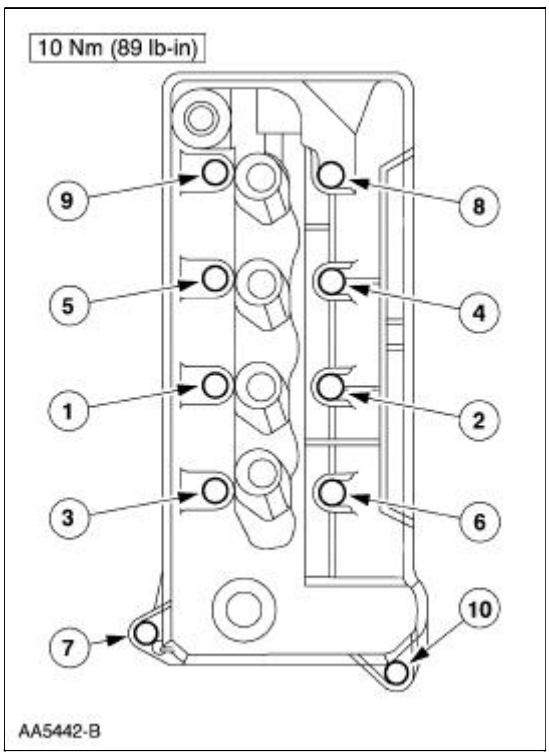
7. Install the coolant pump pulley and the bolts.



8. Install the LH valve cover and loosely install the bolts.



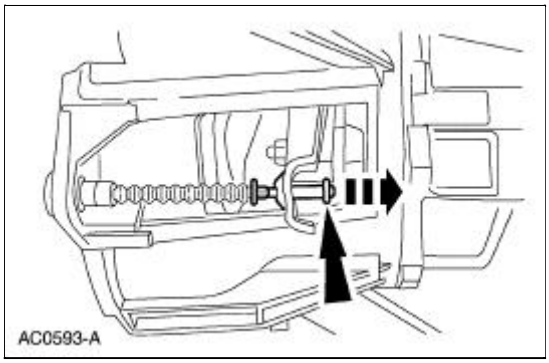
9. Tighten the LH valve cover bolts in the sequence shown.



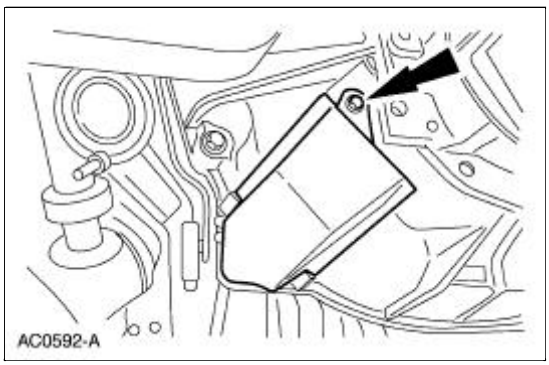
10. Raise and support the vehicle. For additional information, refer to Section 100-02 .

Manual transmission vehicles

11. Connect the clutch release cable to the clutch release fork.

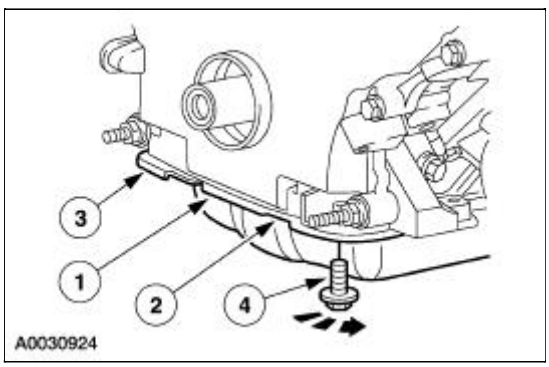


12. Install the clutch release cable shield and the bolt.

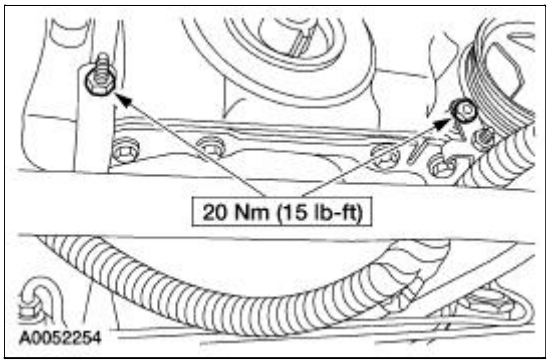


All vehicles

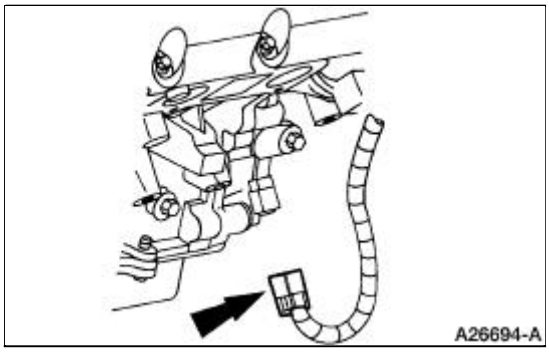
13. Loosely install the four oil pan bolts. Tighten the bolts in three stages, and in the sequence shown.
    1. Stage 1: Tighten the bolts to 2 Nm (18 lb-in).
    2. Stage 2: Tighten the bolts to 20 Nm (15 lb-ft).
    3. Stage 3: Tighten the bolts an additional 90 degrees (1/4 turn).



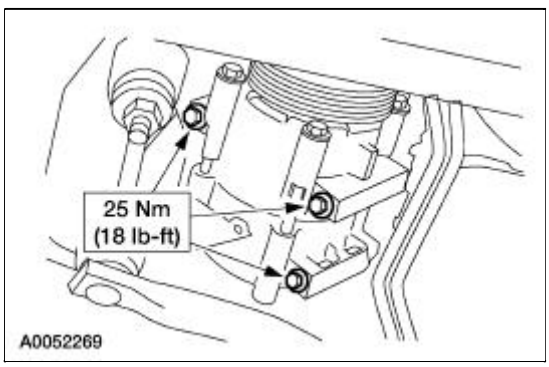
14. Position the wiring harness and install the nuts.



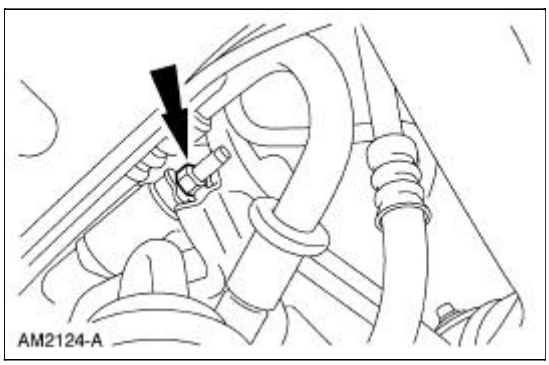
15. Connect the crankshaft position (CKP) sensor electrical connector.



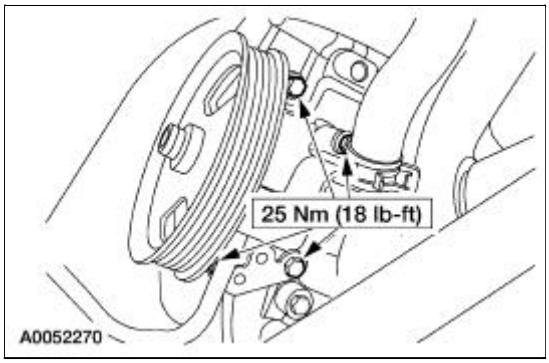
16. Position the A/C compressor, A/C muffler, and the hose. Install the bolts.



17. Install the A/C muffler bracket nut.

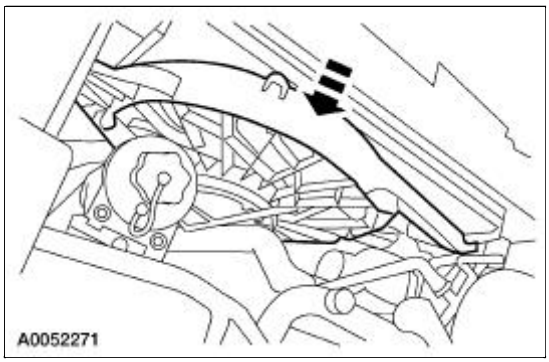


18. Position the power steering pump and install the bolts.

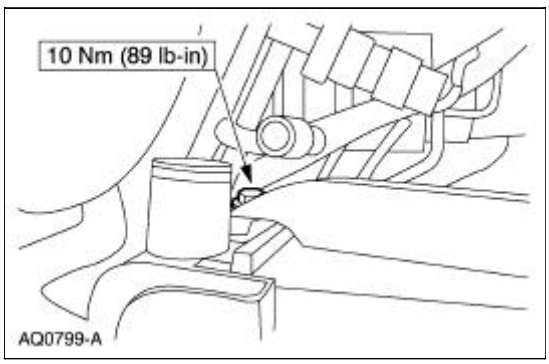


19. Install the crankshaft front oil seal. For additional information, refer to Crankshaft Front Oil Seal in this section.

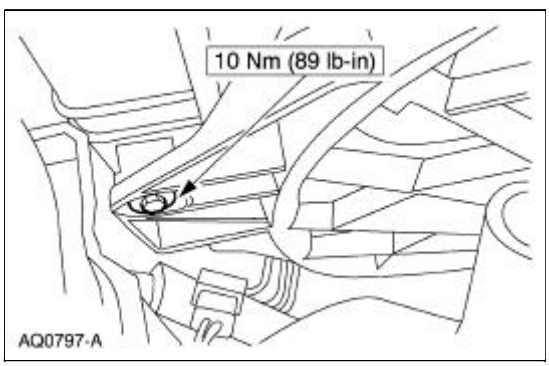
20. Position the cooling fan and shroud in the installed position.



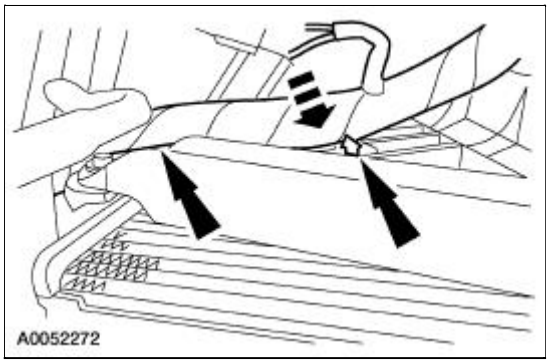
21. Install the RH cooling fan bolt.



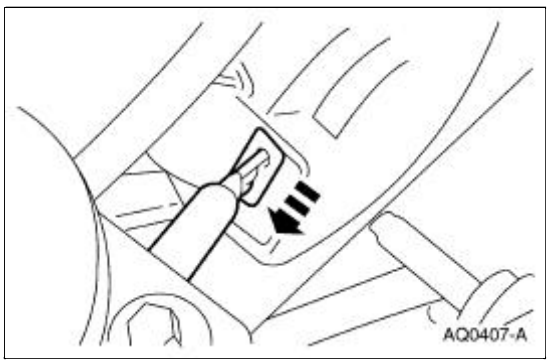
22. Install the LH cooling fan bolt.



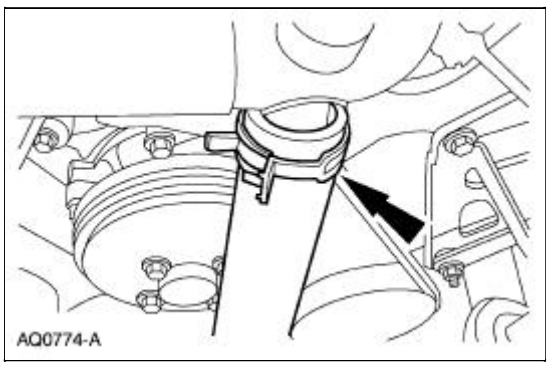
23. Attach the cooling fan wiring harness to the fan shroud.



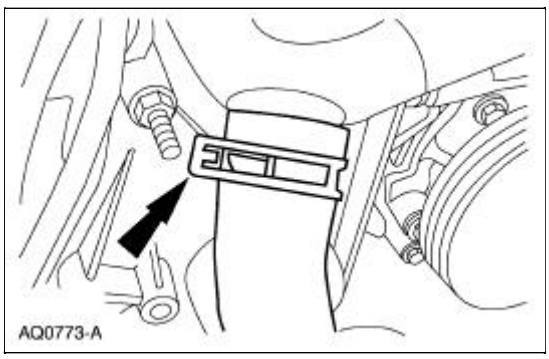
24. Connect the cooling fan electrical connector.



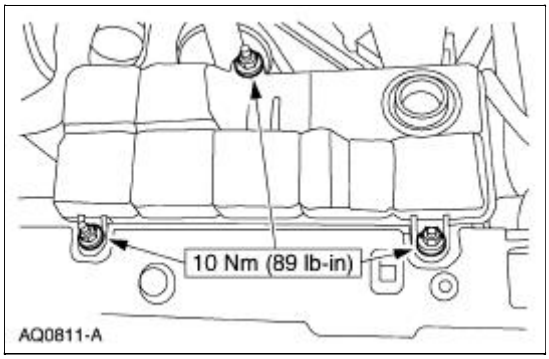
25. Connect the lower radiator hose to the bypass tube.



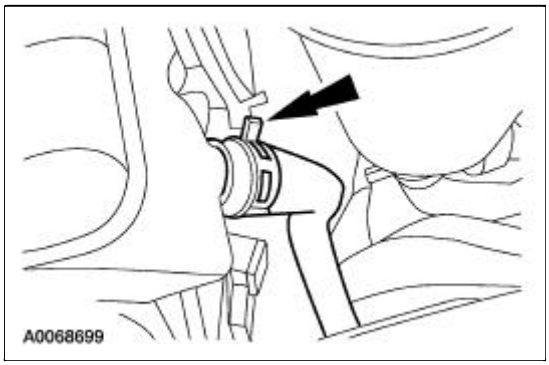
26. Connect the upper radiator hose to the bypass tube.



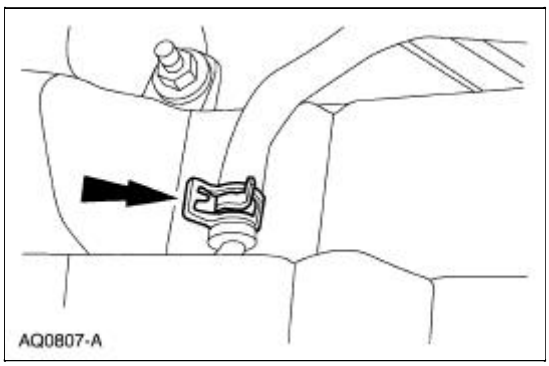
27. Install the degas bottle and the nuts.



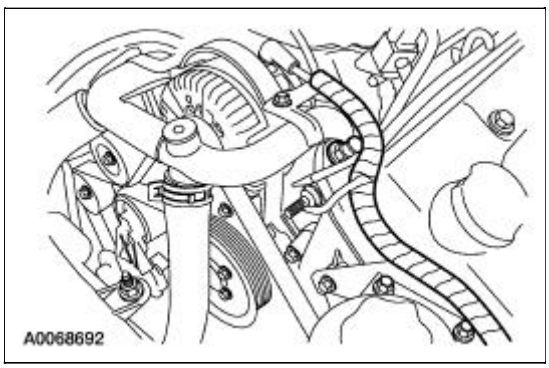
28. Connect the degas bottle return hose.



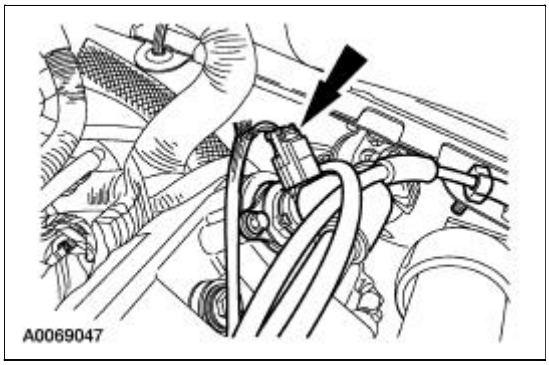
29. Connect the degas bottle vent hose.



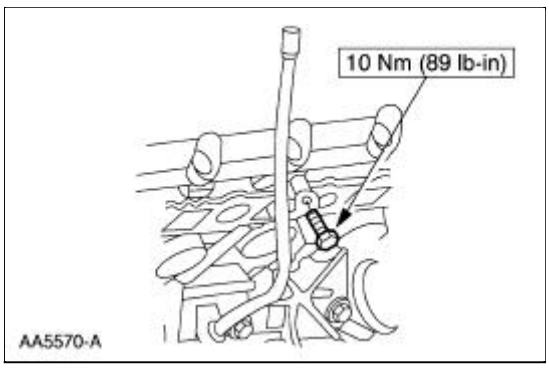
30. Connect the wiring harness anchor to the valve cover.



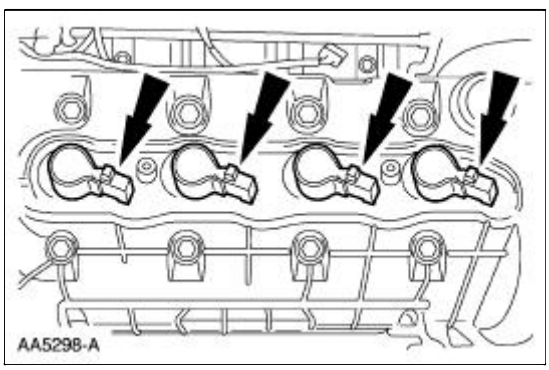
31. Install the positive crankcase ventilation (PCV) valve hose and connect the electrical connector.



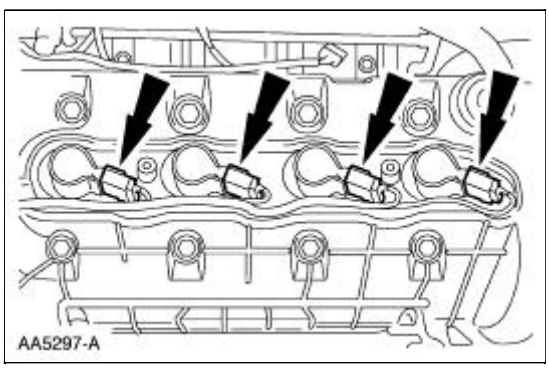
32. Position the oil level indicator tube and install the bolt.



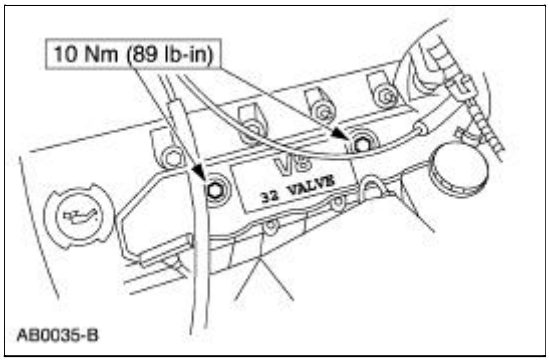
33. Install the LH ignition coils.



34. Connect the LH ignition coil electrical connectors.

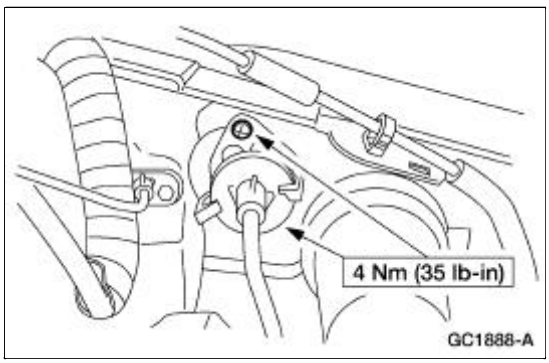


35. Install the LH coil cover and install the bolts.



Manual transmission vehicles

36. Install the clutch release cable screws.



All vehicles

37. Install the RH valve cover. For additional information, refer to Valve Cover RH in this section.
38. Install the Hydro-Boost brake booster. For additional information, refer to Section 206-07 .
39. Install the air intake scoop bracket. For additional information, refer to Section 303-12 .
40. Fill the crankcase with clean engine oil.

Timing Drive Components

Special Tool(s)

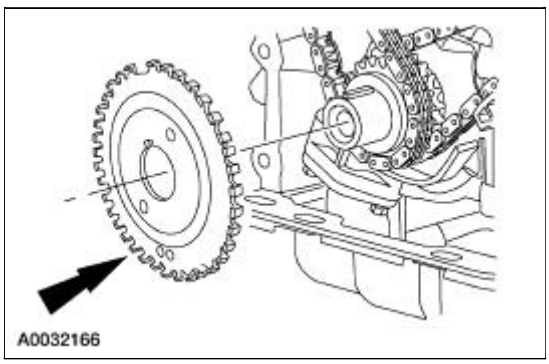
ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)

Removal

CAUTION: Since the engine is not free-wheeling, if the crankshaft or the camshafts are moved in any manner during removal and installation, the crankshaft and the camshafts must be re-synchronized.

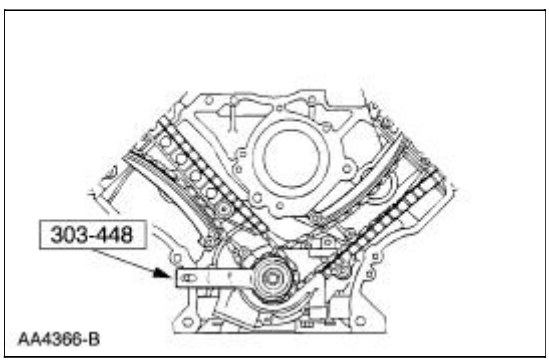
1. Remove the engine front cover. For additional information, refer to Engine Front Cover in this section.

2. Remove the crankshaft sensor ring from the crankshaft.



3. **CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.**

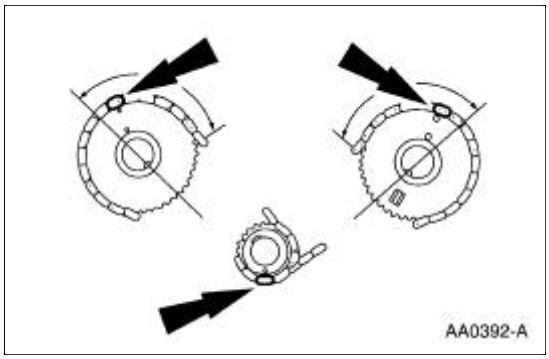
   Using the special tool, position the crankshaft as shown.



4. **CAUTION: The camshaft timing marks must be correctly lined up or damage to the valves and pistons can occur.**

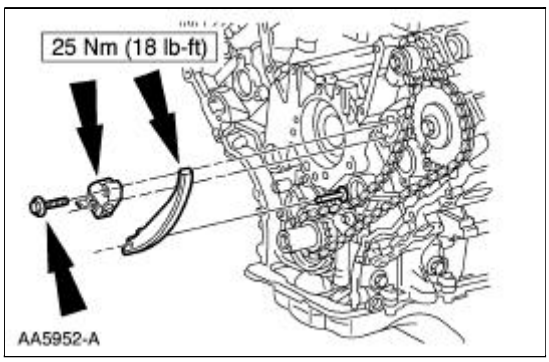
   NOTE: The copper links on the timing chain may not line up with the timing marks on the sprockets.

   Make sure the timing marks on the camshaft sprockets are correctly positioned. If necessary, turn the crankshaft one full turn clockwise to correctly position the sprockets.



5. **NOTE:** LH shown; RH similar.

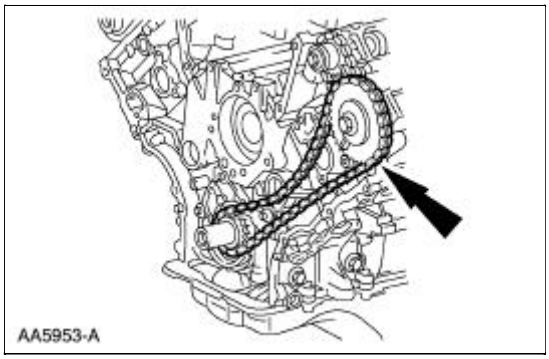
   Remove the two bolts, the timing chain tensioner and tensioner arm.



6. **CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.**

   Remove the LH and RH timing chains and the crankshaft sprocket.

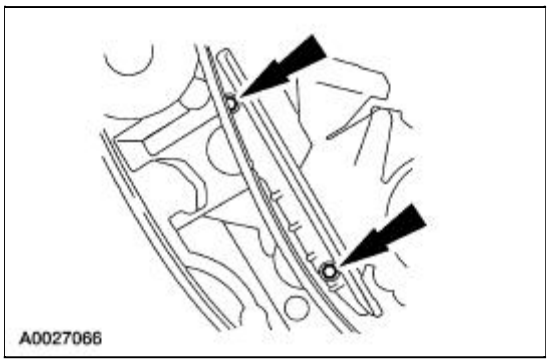
   - Remove the special tool from the crankshaft.
   - Remove the RH timing chain from camshaft sprocket.
   - Remove the RH timing chain from the crankshaft sprocket.
   - Remove the LH timing chain from the camshaft sprocket.
   - Remove the LH timing chain and the crankshaft sprocket.



7. **CAUTION: The bolts are different lengths and must be returned to their original location.**

   NOTE: RH shown; LH similar.

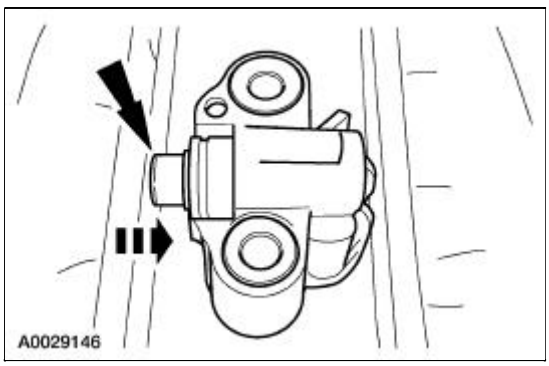
   Remove the bolts and the timing chain guides.



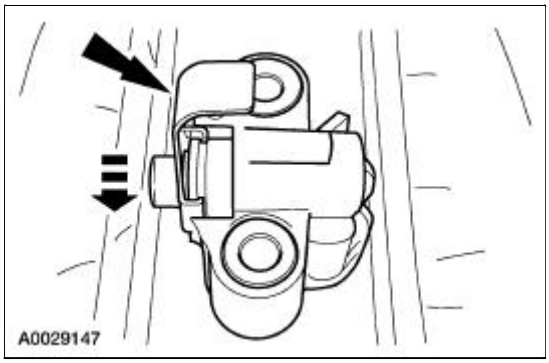
Installation

1. **CAUTION: Timing chain procedures must be followed exactly or damage to the pistons or valves will result.**

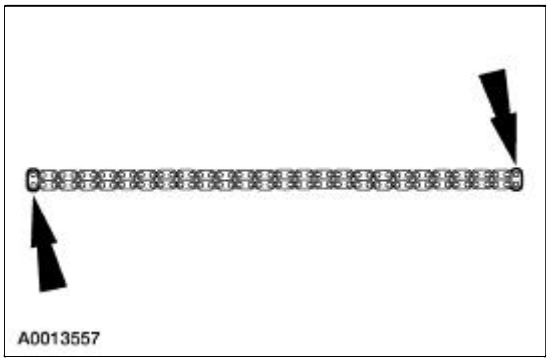
   Compress the tensioner plunger, using a soft-jawed vise.



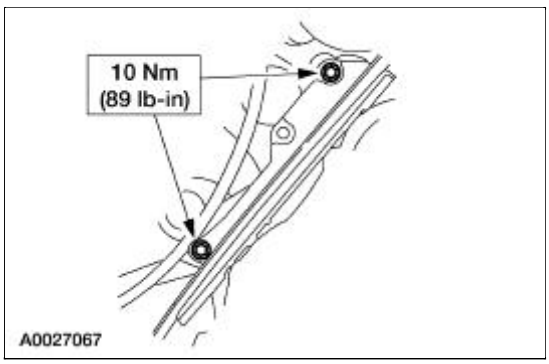
2. Install a retaining clip on the tensioner to hold the plunger in during installation.
   - Remove the tensioner from the vise.



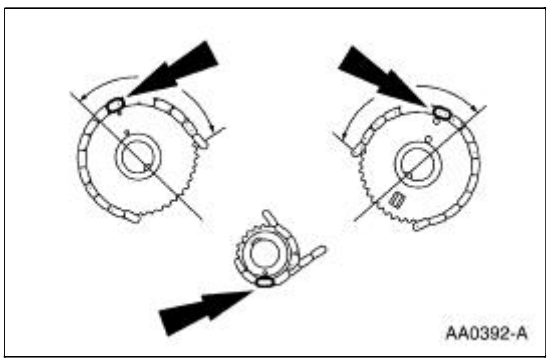
3. If the copper links are not visible, mark one link on one end and one link on the other end, and use as timing marks.



4. Install the timing chain guides.



5. Rotate the LH camshaft sprocket until the timing mark is approximately at the 12 o' clock position. Rotate the RH camshaft timing sprocket until the timing mark is approximately in the 11 o' clock position.

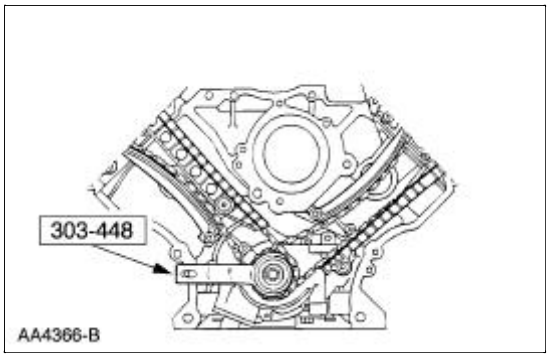


6. **CAUTION: Unless otherwise instructed, at no time when the timing chains are**

removed and the cylinder heads are installed is the crankshaft or the camshaft to be rotated. Severe piston and valve damage will occur.

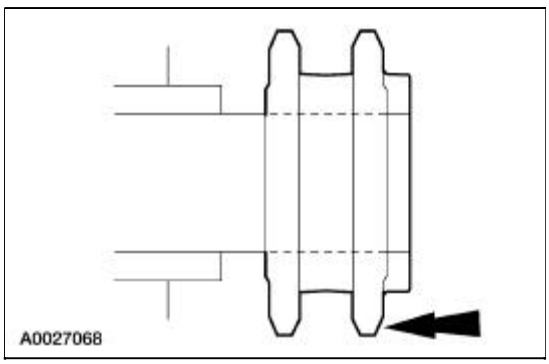
CAUTION: Rotate the crankshaft counterclockwise only. Do not rotate past position shown or severe piston or valve damage will occur.

Using the special tool, position the crankshaft.



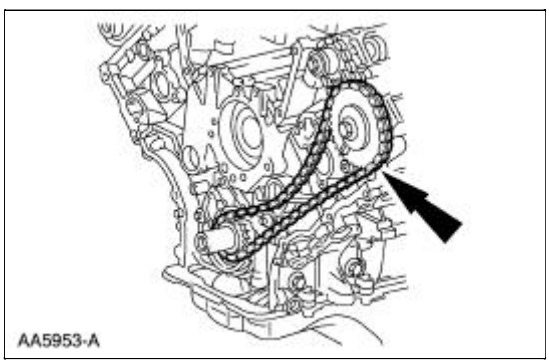
7. Remove the special tool.

8. Install the crankshaft sprocket with the flange facing forward.

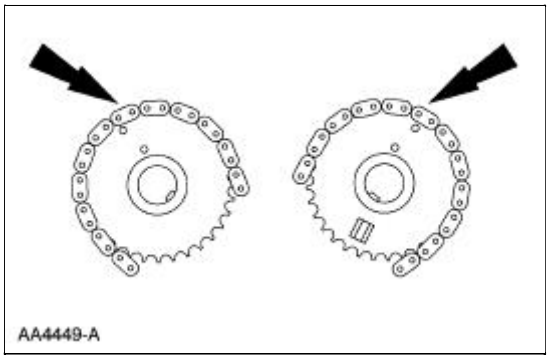


9. **NOTE:** LH timing chain shown; RH similar.

   Install the LH timing chain onto the crankshaft sprocket, aligning the one copper link on the timing chain with the slot on the crankshaft sprocket.

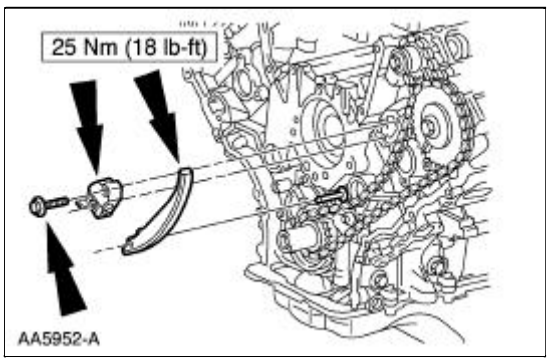


10. Verify the camshaft sprocket to copper link alignment.

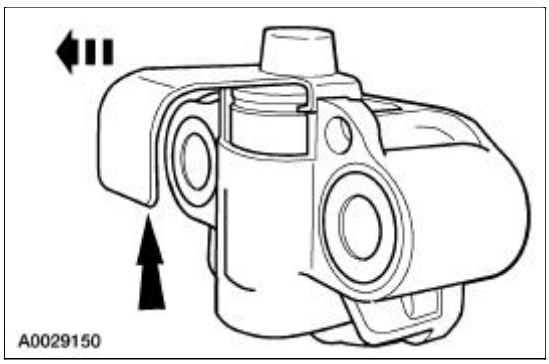


11. **NOTE:** LH shown; RH similar.

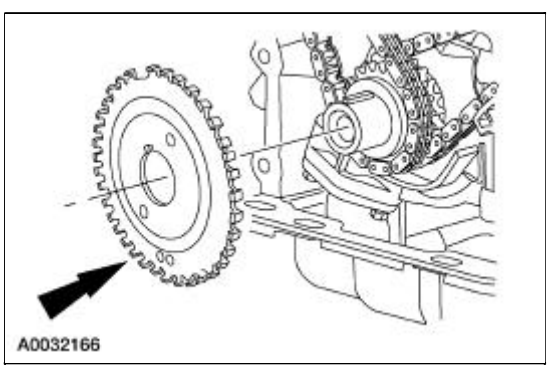
    Position the tensioner arms and tensioners, and install the bolts.



12. Remove the retaining clips from the timing chain tensioners.



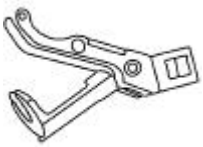
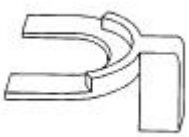
13. Position the crankshaft sensor ring on the crankshaft.



14. Install the engine front cover. For additional information, refer to Engine Front Cover in this section.

Valve —Springs, Retainer and Valve Stem Seal

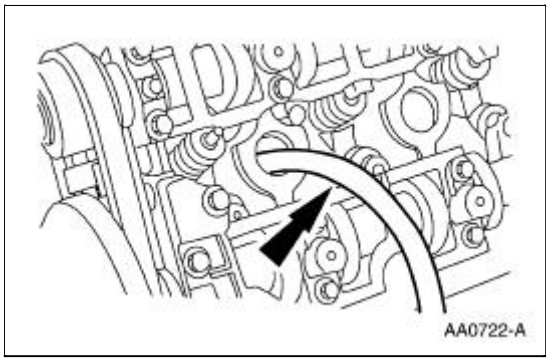
Special Tool(s)

ST1718-A	Compressor, Valve Spring 303-452 (T93P-6565-AR)
ST1332-A	Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)
 ST1693-A	Compressor, Valve Spring 303-567 (T97P-6565-AH)
 ST1331-A	Spacer, Valve Spring Compressor 303-382 (T91P-6565-AH)

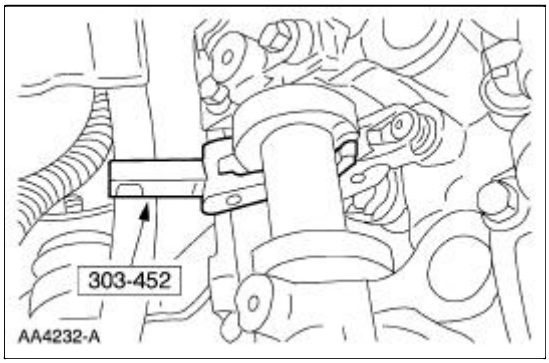
Removal

1. Remove the roller followers. For additional information, refer to Roller Followers in this section.
2. Remove the spark plugs. For additional information, refer to Section 303-07C .
3. Position the piston of the cylinder being serviced at the bottom of the stroke.
4. **CAUTION: If air pressure has forced the piston to the bottom of the cylinder any loss of air pressure will allow the valve to fall into the cylinder. If air pressure must be removed support the valve prior to removal.**

   Use compressed air in the cylinder to hold both valves in position.

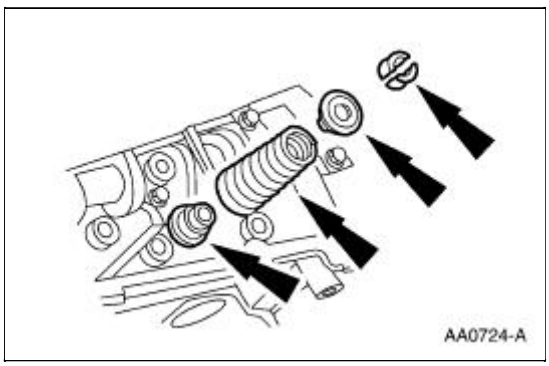


5. Using the special tool, compress the intake valve spring.

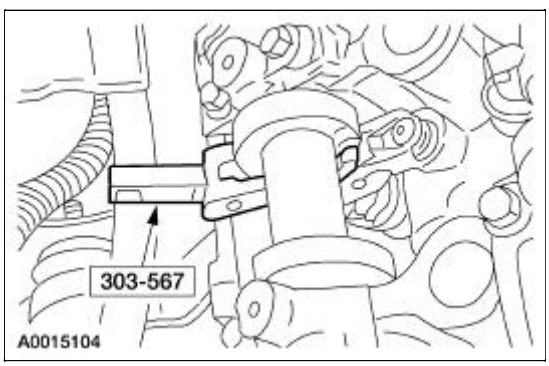


6. **NOTE:** Valve stem seals should be visually inspected if new seals are not installed.

   Remove the valve spring retainer keys, the valve spring retainer, the valve spring and the valve stem seal.

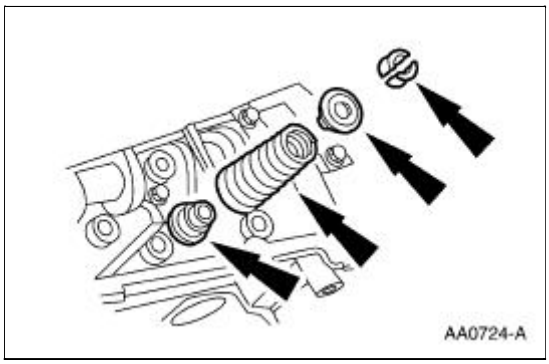


7. Using the special tool, compress the exhaust valve spring.



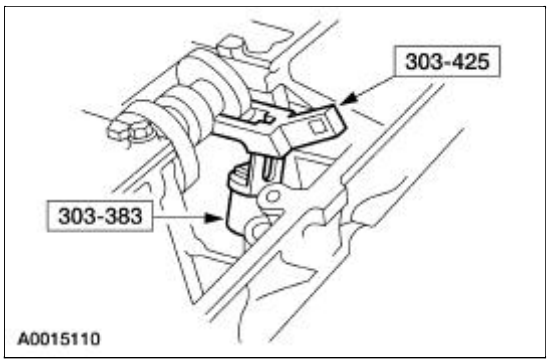
8. **NOTE:** Valve stem seals should be visually inspected if new seals are not installed.

Remove the valve spring retainer keys, the valve spring retainer, the valve spring and the valve stem seal.

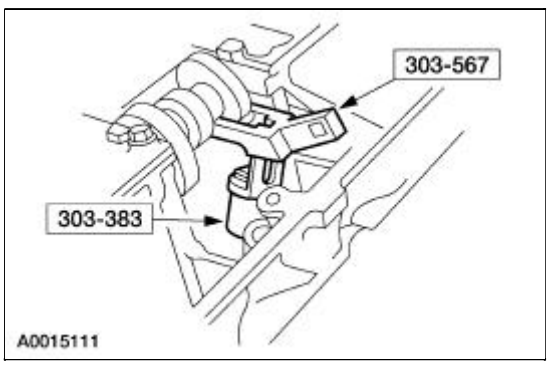


Installation

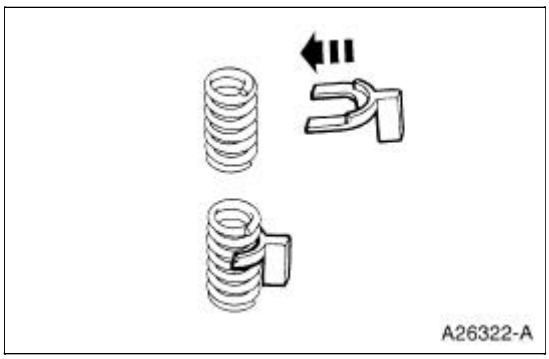
1. Using the special tools, install the new intake valve stem seals.



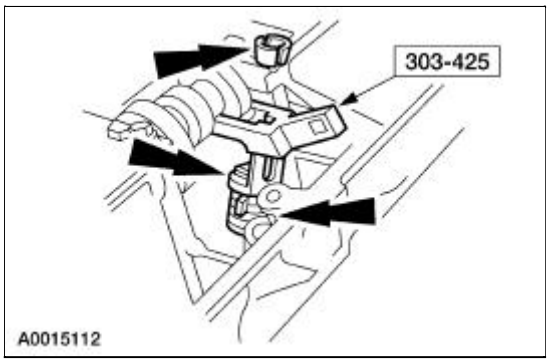
2. Using the special tools, install the new exhaust valve stem seals.



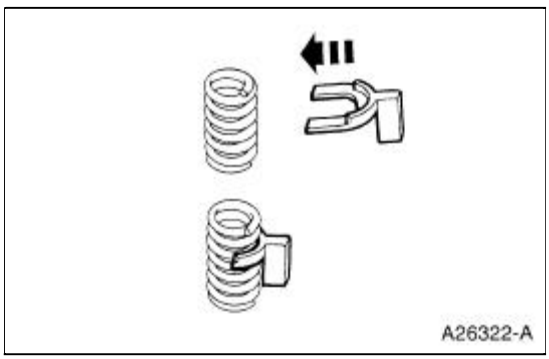
3. Install the Valve Spring Compressor Spacer between the valve spring coils to protect the intake valve stem seal from damage.



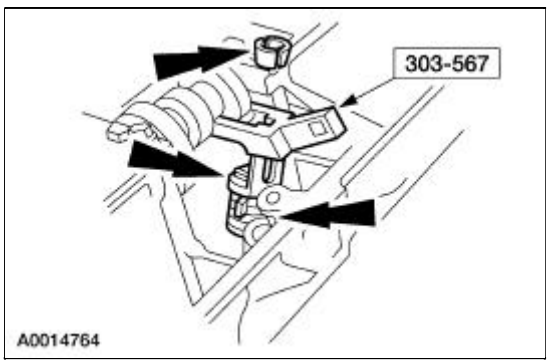
4. Using the special tool, install the intake valve spring, the spring retainer and the valve spring retainer keys.



5. Install the Valve Spring Compressor Spacer between the valve spring coils to protect the intake valve stem seal from damage.



6. Using the special tool, install the exhaust valve spring, the spring retainer and the valve spring retainer keys.



7. Remove the compressed air hose from the cylinder.

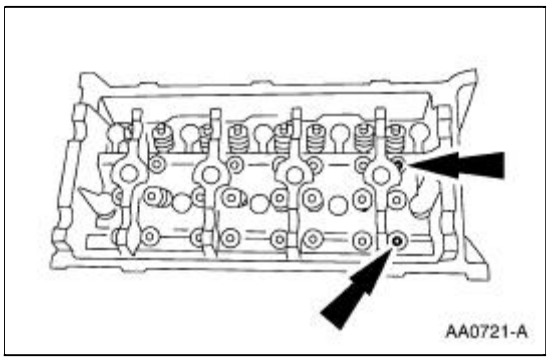
8. Install the spark plugs. For additional information, refer to Section 303-07C .

9. Install the roller followers. For additional information, refer to Roller Followers in this section.

Hydraulic Lash Adjusters

Removal

1. Remove the roller followers. For additional information, refer to Roller Followers in this section.
2. Remove the 16 hydraulic lash adjusters.



3. Inspect the roller followers. For additional information, refer to Section 303-00 .

Installation

1. To install, reverse the removal procedure.

Roller Followers

Special Tool(s)

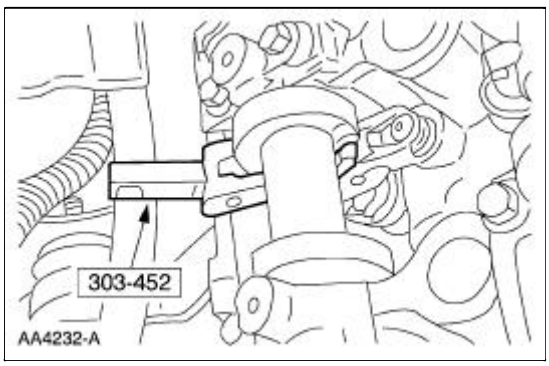
ST1718-A	Compressor, Valve Spring 303-452 (T93P-6565-AR)

Removal and Installation

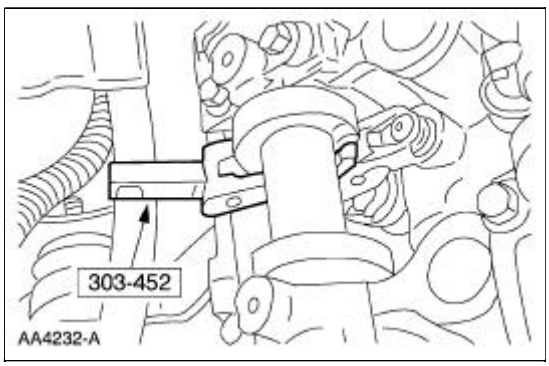
1. Remove the LH and RH valve cover. For additional information, refer to Valve Cover LH and Valve Cover RH in this section.

2. Position the piston of the cylinder being repaired at the bottom of the stroke and camshaft lobe at base circle.

3. Using the special tool, compress the intake valve spring and remove the roller follower.



4. Using the special tool, compress the exhaust valve spring and remove the roller follower.

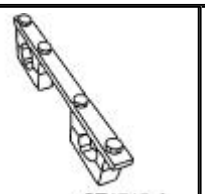


5. Repeat Steps 2, 3 and 4 to remove all the necessary roller followers. Inspect roller finger followers and camshafts. For additional information, refer to Section 303-00 .

6. To install, reverse the removal procedure.

Camshaft

Special Tool(s)

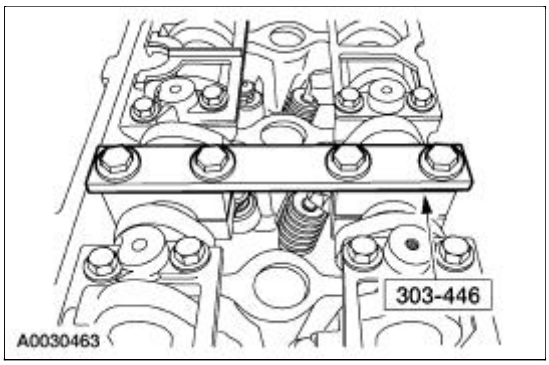
 ST1715-A	Holding Tool, Camshaft 303-446 (T93P-6256-AHR)

Material

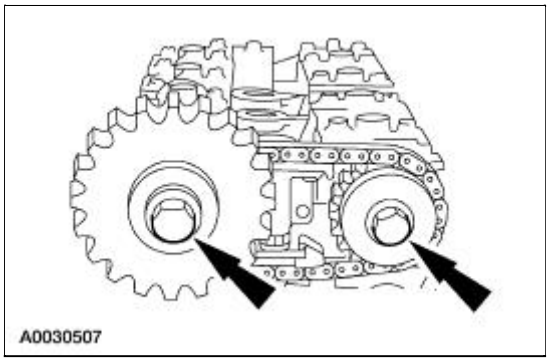
Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

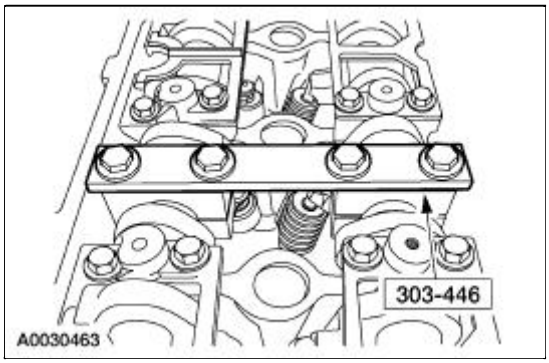
1. Remove the roller followers. For additional information, refer to Roller Followers in this section.
2. Remove the LH timing chain for the LH side and both timing chains for the RH side. For additional information, refer to Timing Drive Components in this section.
3. Install the special tool.



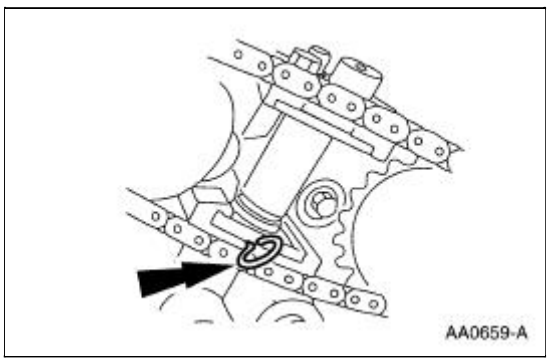
4. Remove the exhaust camshaft sprocket and the intake camshaft bolt, washer and spacer.



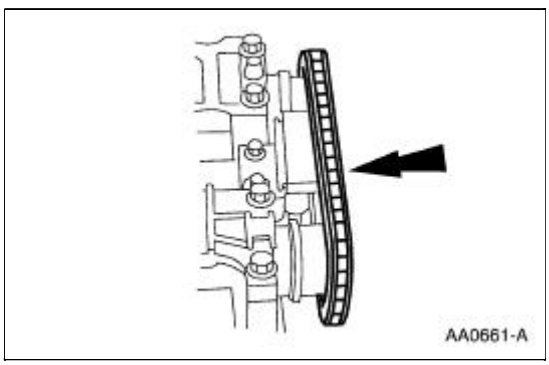
5. Remove the special tool.



6. Compress the tensioner and install a lock pin.

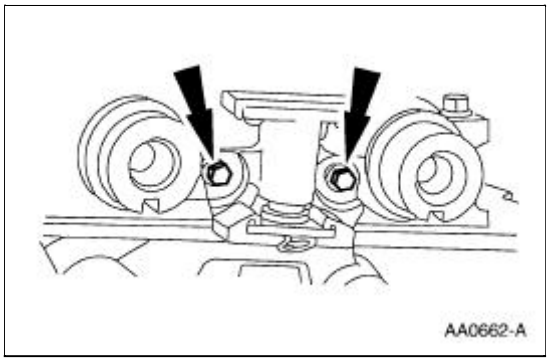


7. Remove the timing chain, the sprocket, and intake camshaft sprocket spacer.



8. **NOTE:** LH shown; RH similar.

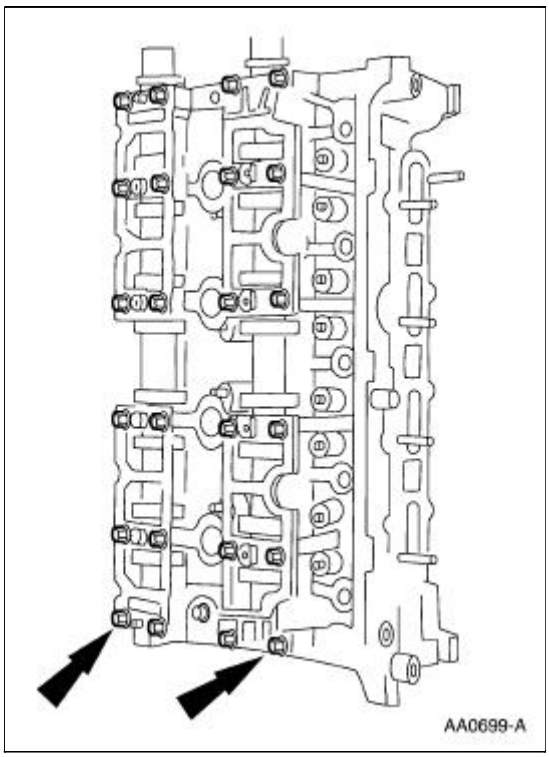
   Remove the bolts.



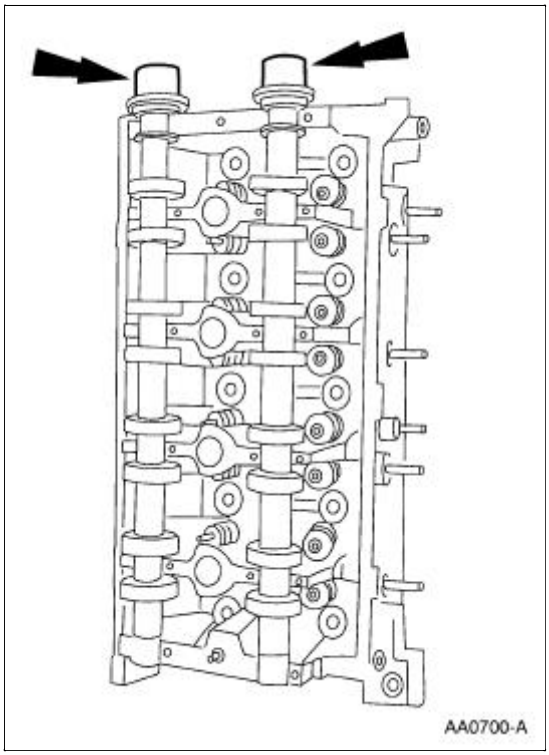
9. **CAUTION: The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage may occur.**

   NOTE: Identify the camshaft to cylinder head location. Caps are not interchangeable.

   Remove the bolts and the camshaft bearing cap assemblies.



10. Remove the camshafts.

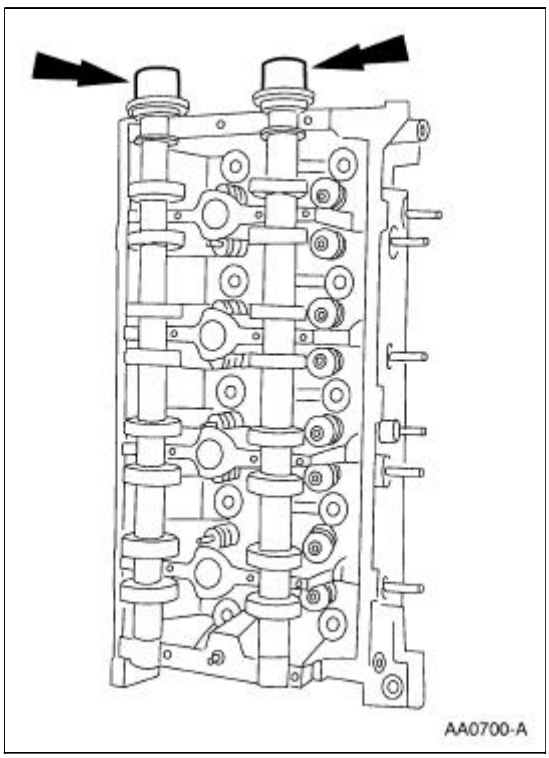


Installation

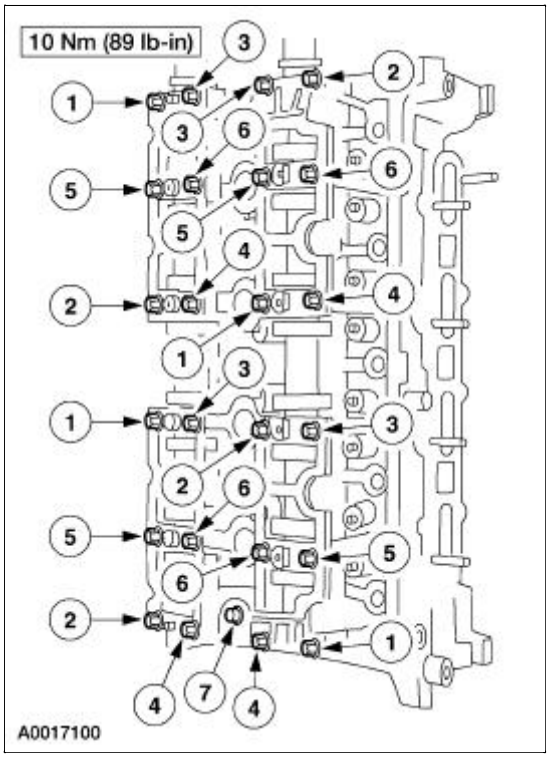
1. **NOTE:** LH shown; RH similar.

   Install the camshafts.

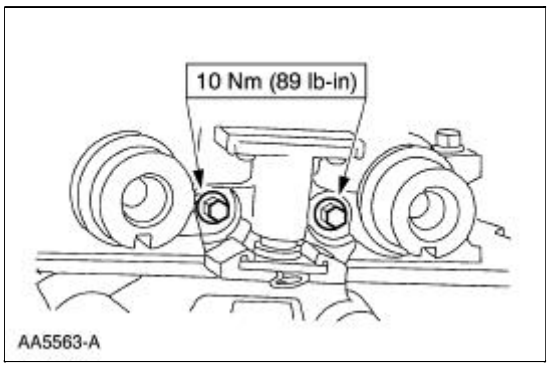
   - Lubricate the camshafts with clean engine oil.



2. Install the camshaft bearing cap assemblies and tighten the bolts in the sequence shown.

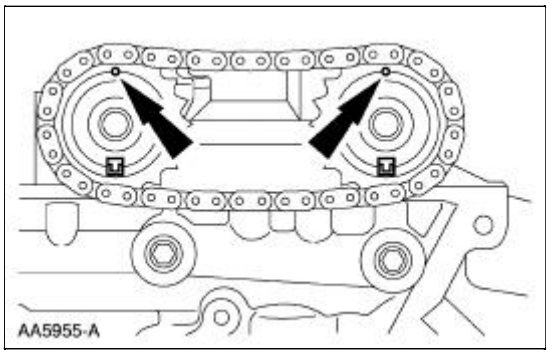


3. Install the bolts.

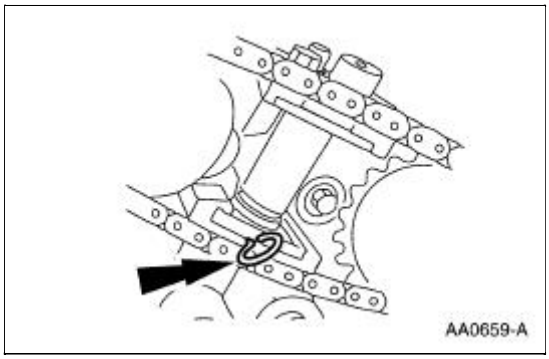


4. **CAUTION: Timing marks must be at 12 o'clock and indexed at 6 o'clock.**

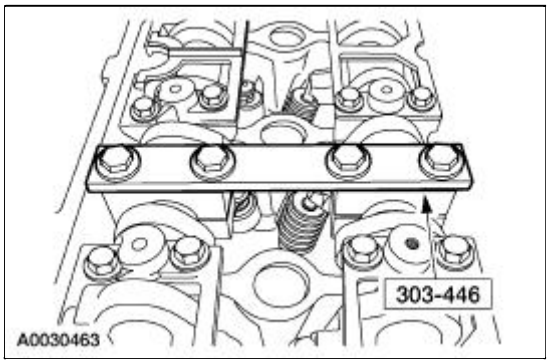
   Install the camshaft sprockets and the chain as an assembly.



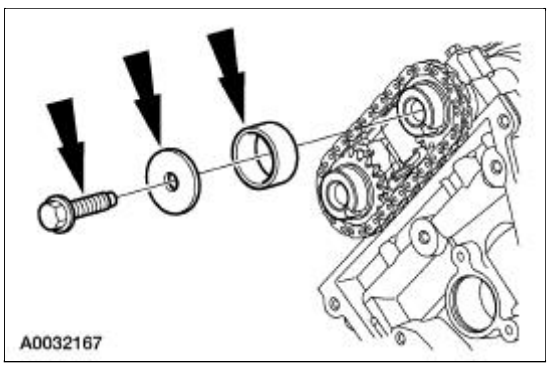
5. Remove the lockpin from the chain tensioner.



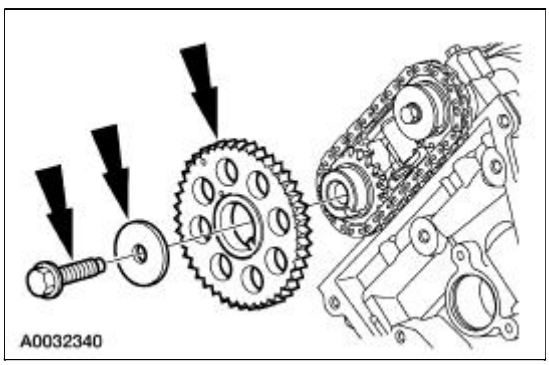
6. Install the special tool.



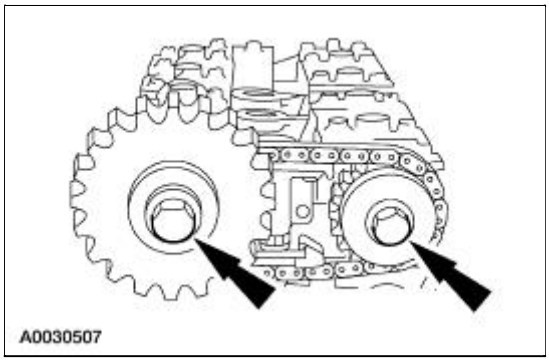
7. Install the camshaft spacer, washer and bolt and hand-tighten the bolt.



8. Install the camshaft sprocket, washer and bolt, and hand-tighten the bolt.



9. Tighten the bolts in two stages:
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Tighten an additional 90 degrees.



10. Remove the special tool.

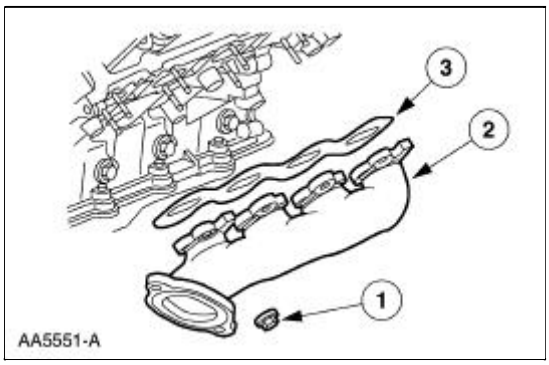
11. Install the left timing chain for the left side or both timing chains for the right side. For additional information, refer to Timing Drive Components in this section.

12. Install the roller followers. For additional information, refer to Roller Followers in this section.

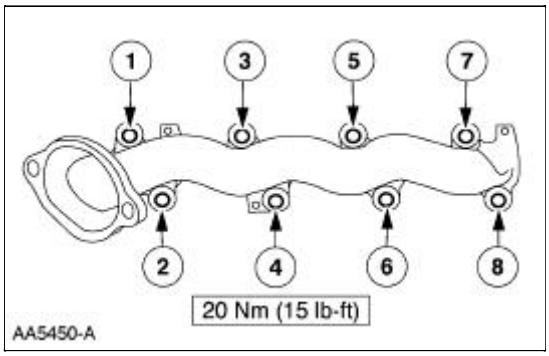
Exhaust Manifold RH

Removal and Installation

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Raise the vehicle. For additional information, refer to Section 100-02 .
3. Remove the dual converter Y-pipe. For additional information, refer to Section 309-00 .
4. Remove the starter. For additional information, refer to Section 303-06 .
5. Remove the exhaust manifold.
    1. Remove the nuts.
    2. Remove the exhaust manifold.
    3. Remove and discard the gasket.



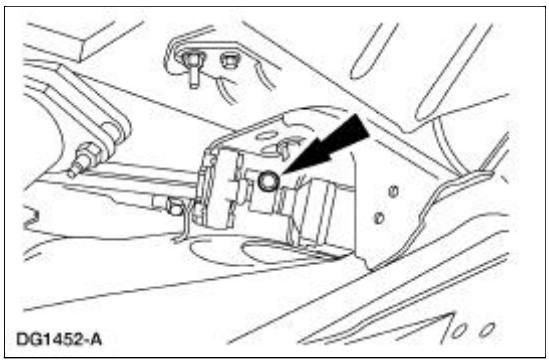
6. To install, reverse the removal procedure.
    - Use a new exhaust manifold gasket.
    - Tighten the exhaust manifold nuts in the sequence shown.



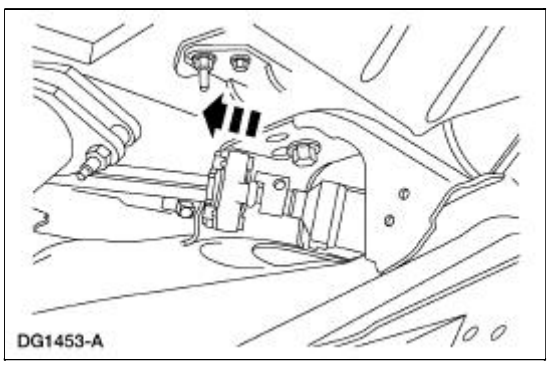
Exhaust Manifold LH

Removal and Installation

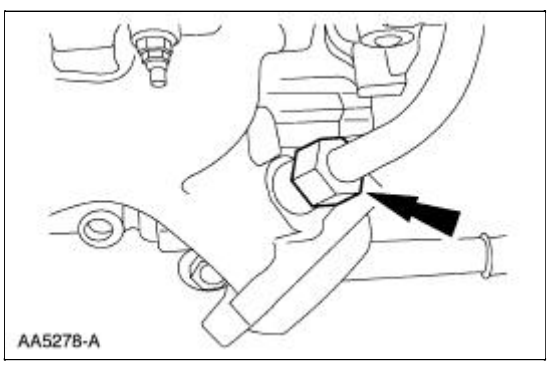
1. Position the steering wheel straight ahead and lock the column.
2. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
3. Raise the vehicle. For additional information, refer to Section 100-02 .
4. Remove the dual converter Y-pipe. For additional information, refer to Section 309-00 .
5. Remove and discard the pinch bolt.



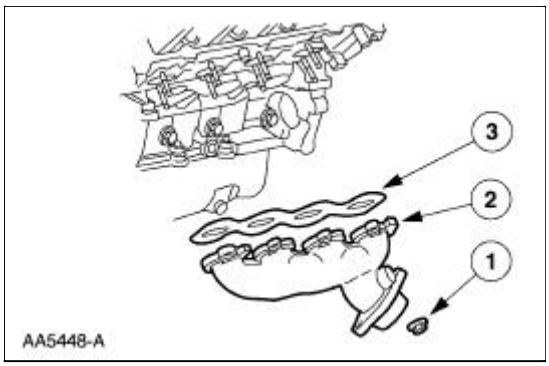
6. Separate the steering coupler.



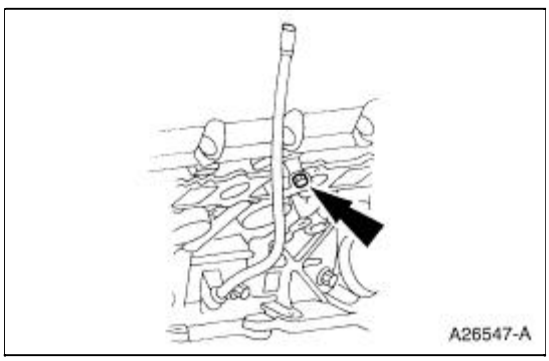
7. Disconnect the exhaust gas recirculation (EGR) tube at the exhaust manifold.



8. Remove the exhaust manifold.
    1. Remove the nuts.
    2. Remove the exhaust manifold.
    3. Remove and discard the gasket.

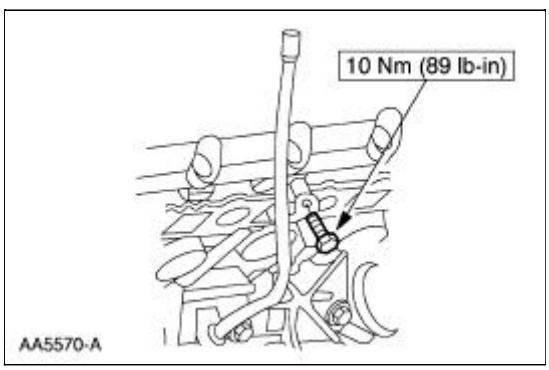


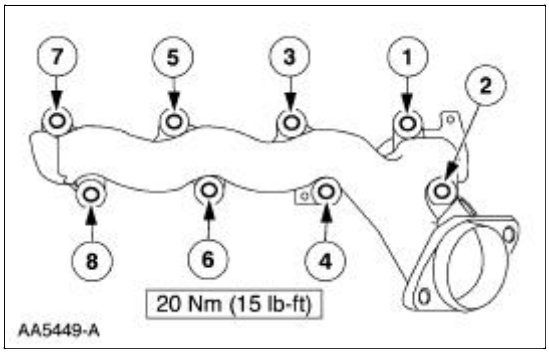
9. Remove the oil level indicator tube.

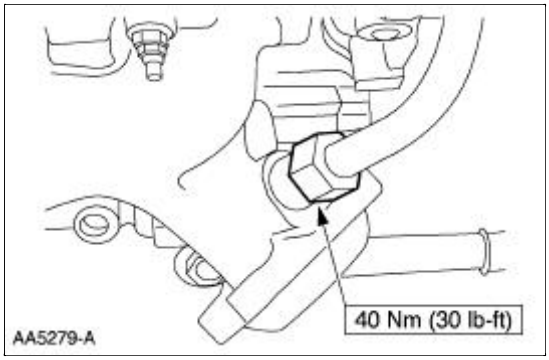


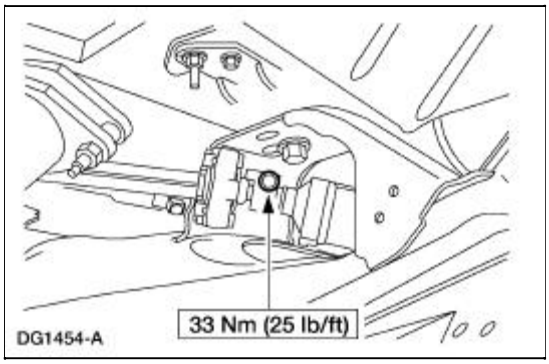
10. Remove and discard the exhaust manifold gasket.

11. To install, reverse the removal procedure.
    - Use a new exhaust manifold gasket.




7
5
3
1
2
8
6
4
20 Nm (15 lb-ft)
AA5449-A

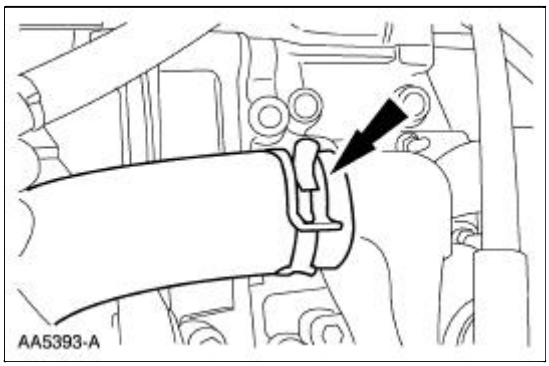

40 Nm (30 lb-ft)
AA5279-A


33 Nm (25 lb/ft)
DG1454-A

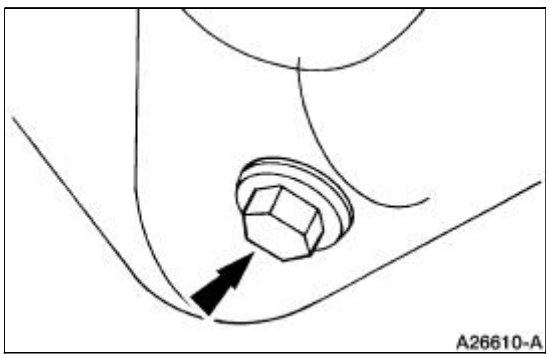
Oil Filter Adapter

Removal

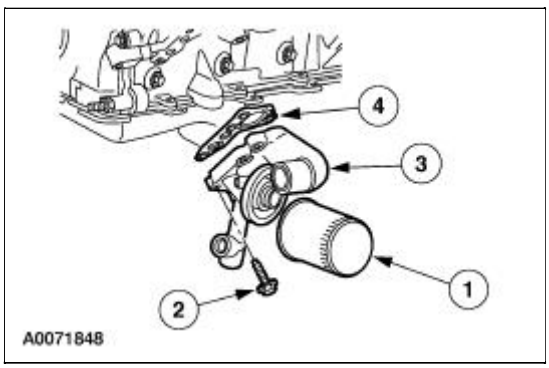
1. Drain the cooling system. For additional information, refer to Section 303-03A .
2. Disconnect the lower radiator hose.



3. Raise the vehicle. For additional information, refer to Section 100-02 .
4. Drain the engine oil.



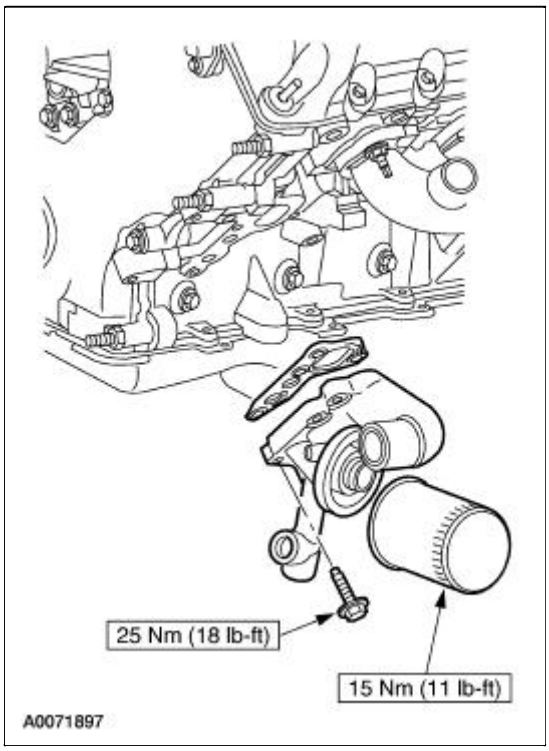
5. Remove the oil filter adapter.
    1. Remove the oil filter.
    2. Remove the bolts.
    3. Remove the oil filter adapter.
    4. Remove the gasket.



6. Clean and inspect the oil filter adapter.
    - Flush the oil filter adapter with parts cleaner. If metal particles are present in the adapter, install a new adapter.

Installation

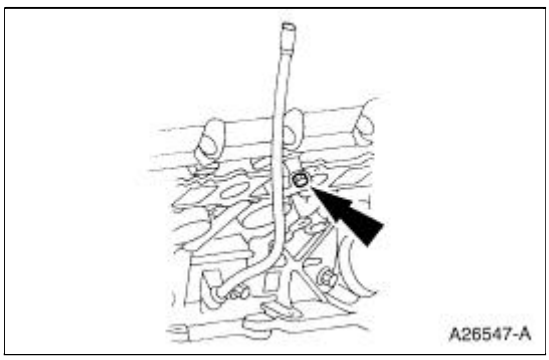
1. To install, reverse the removal procedure.



Oil Level Indicator and Tube

Removal

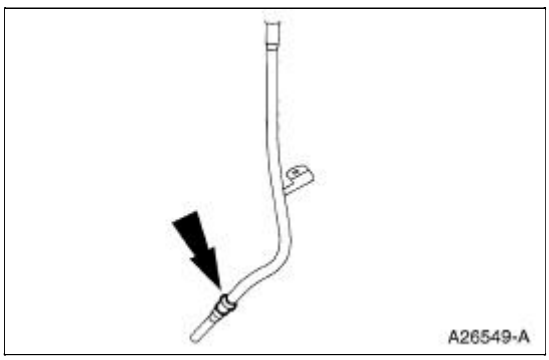
1. Remove the oil level indicator.
2. Remove the LH exhaust manifold. For additional information, refer to Exhaust Manifold LH in this section.
3. Remove the bolt.

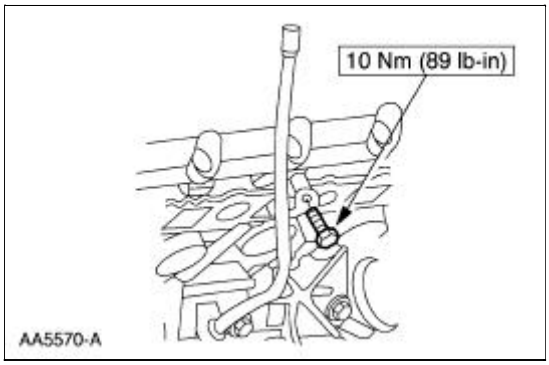


4. Remove the oil level indicator tube.

Installation

1. To install, reverse the removal procedure.




10 Nm (89 lb-in)
AA5570-A

Oil Pan

Special Tool(s)

ST1352-A	Compressor, Coil Spring 204-D001 (D78P-5310-A)
ST1604-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
ST2333-A	3-Bar Engine Support Kit 303-F072

Material

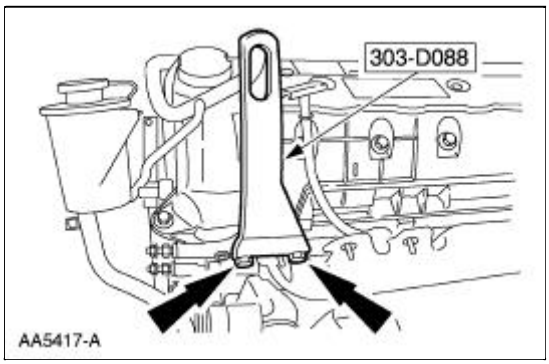
Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

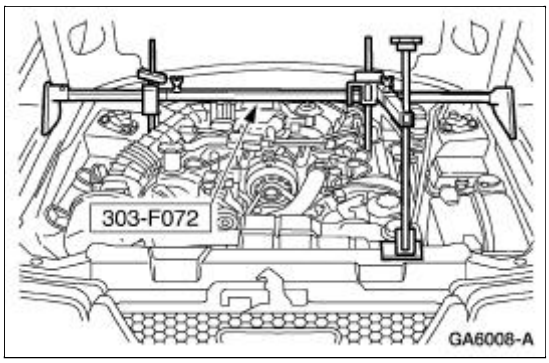
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the transmission. For additional information, refer to Section 307-01 or Section 308-03B .
3. Remove the air intake scoop. For additional information, refer to Section 303-12 .
4. Remove the air cleaner outlet tube. For additional information, refer to Section 303-12 .
5. Remove the radiator sight shield.
6. Remove the manifold and tube assembly—accumulator to compressor, 4.6L. For additional information, refer to Section 412-03 .

7. Remove the A/C line. For additional information, refer to Section 412-03 .

8. Install the special tools.

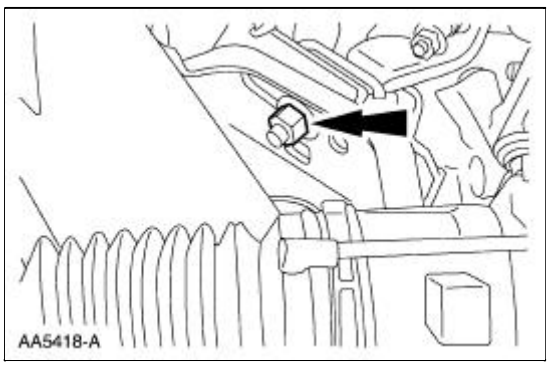


9. Install the special tool.



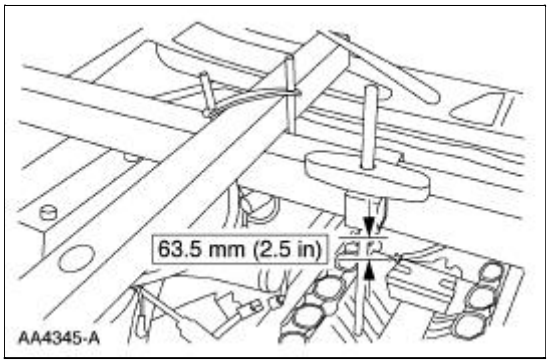
10. Raise the vehicle on a hoist. For additional information, refer to Section 100-02 .

11. Remove the two engine mount nuts.



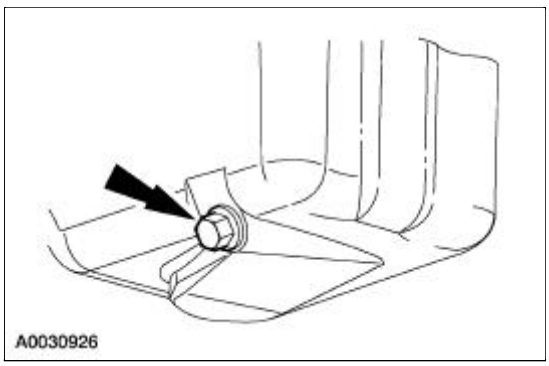
12. Lower the vehicle.

13. Using the special tool, raise the engine.

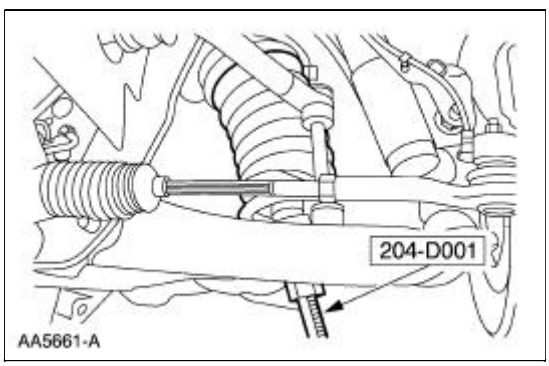


14. Raise the vehicle on a hoist.

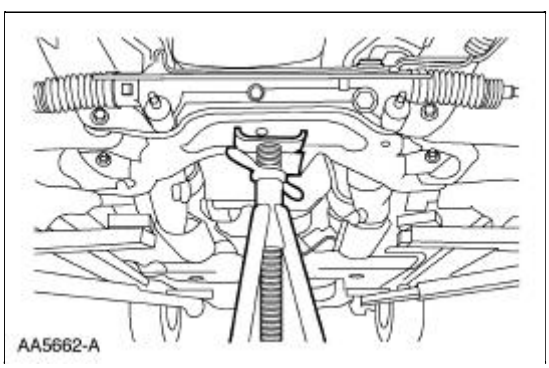
15. Remove the oil pan drain plug and drain the engine oil.



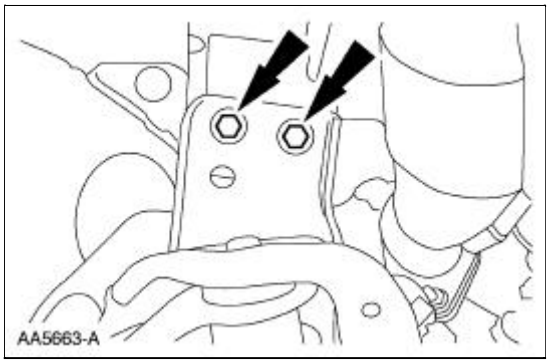
16. Using the special tool, compress the front coil springs.



17. Position a safety stand.

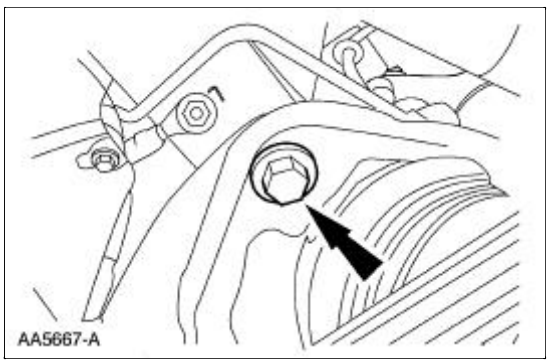


18. Remove the four bolts.

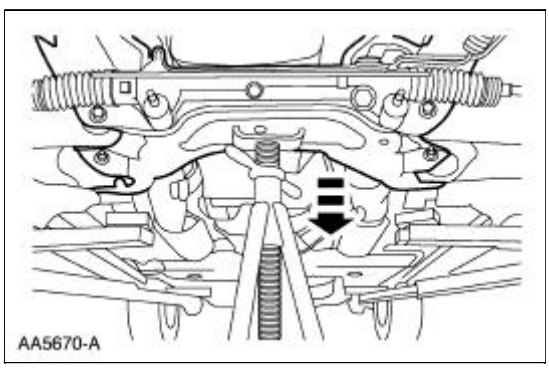


19. **NOTE:** Do not completely remove the bolts.

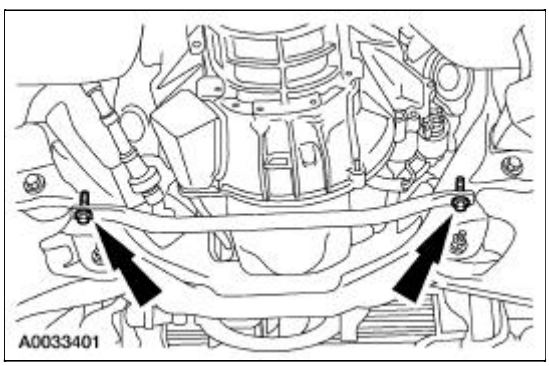
    Loosen the bolts.



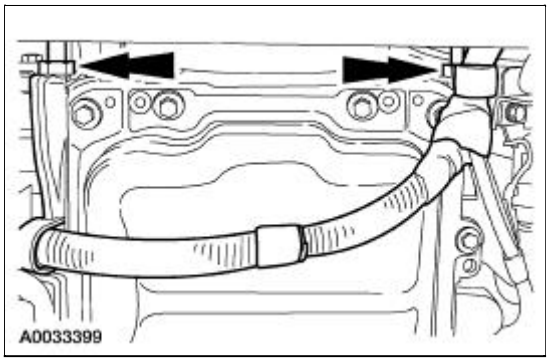
20. Lower the front sub-frame.



21. Remove the sub-frame brace.



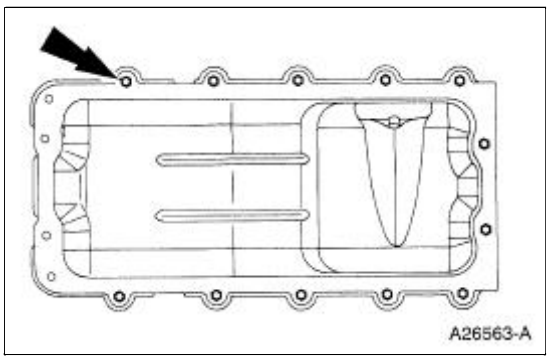
22. Remove the starter wiring harness nuts and position the wiring harness out of the way.



23. **NOTE:** Be careful when removing the oil pan gasket. It is reusable.

    Remove the oil pan and gasket.

    - Inspect the oil pan gasket for damage.



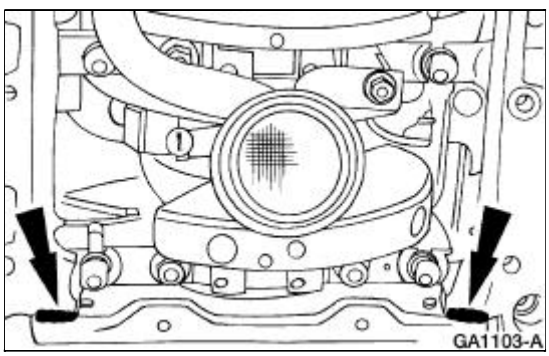
Installation

1. **CAUTION: Do not use metal scrapers, wire brushes, power abrasive discs or other abrasive means to clean the sealing surfaces. These tools cause scratches and gouges which make leak paths. Use a plastic scraping tool to remove all traces of old sealant.**

   Clean and inspect the mating surfaces.

2. **NOTE:** If the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure may result in future oil leakage.

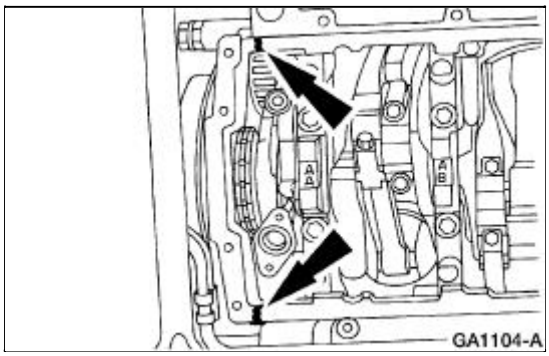
   Apply silicone gasket and sealant at the engine front cover-to-cylinder block mating surface.



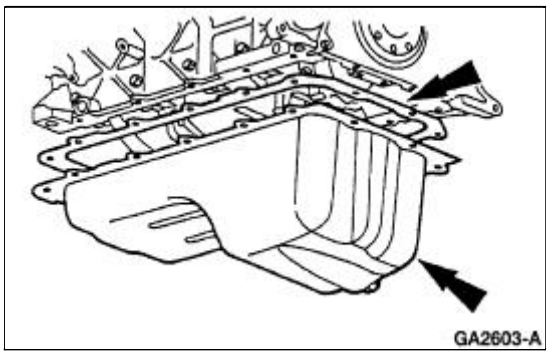
3. **NOTE:** If the if the oil pan is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of

wetness, or four minutes, whichever is longer. Failure to follow this procedure may result in future oil leakage.

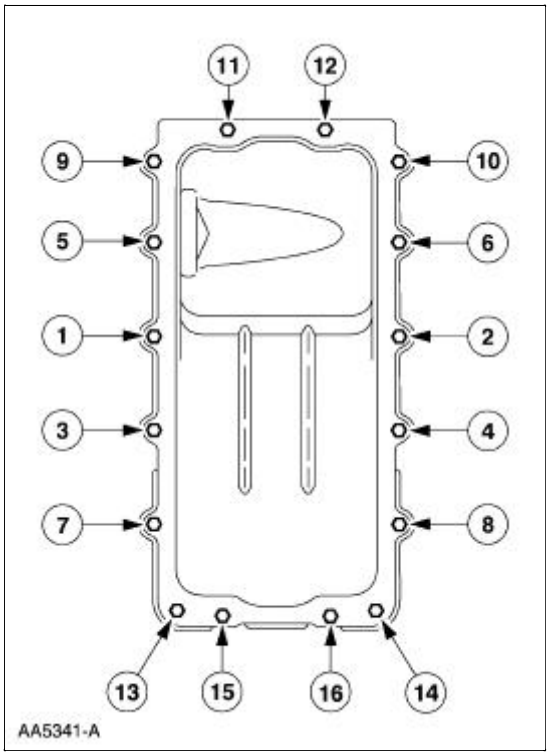
Apply silicone gasket and sealant at the rear oil seal retainer-to-cylinder block sealing surface.



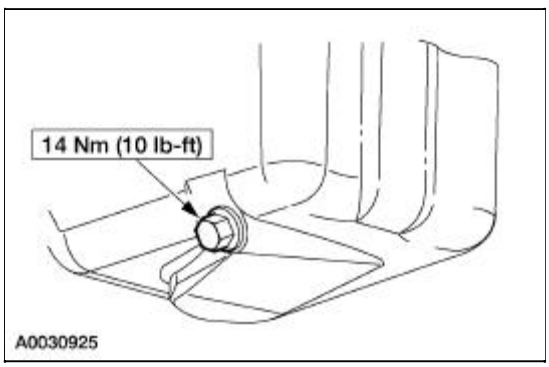
4. Install the oil pan and gasket and loosely install the bolts.



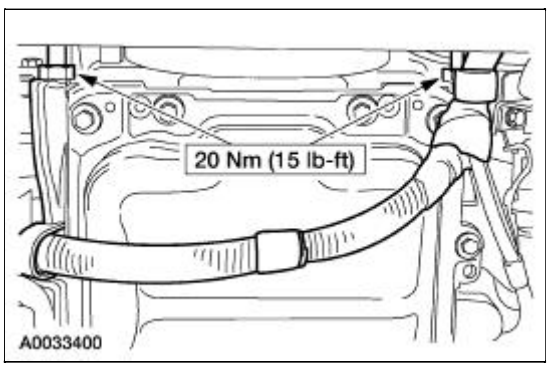
5. Tighten the bolts in the sequence shown in three stages.
    - Stage 1: Tighten to 2 Nm (18 lb-in).
    - Stage 2: Tighten to 20 Nm (15 lb-ft).
    - Stage 3: Tighten an additional 60 degrees.



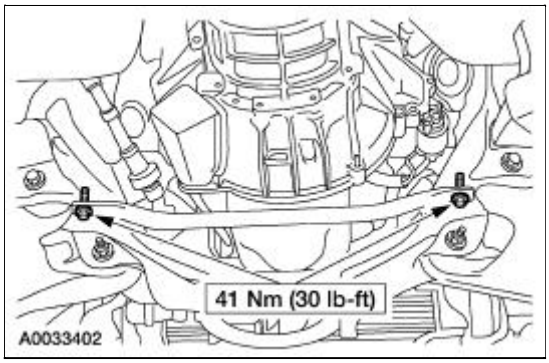
6. Install the oil pan drain plug.



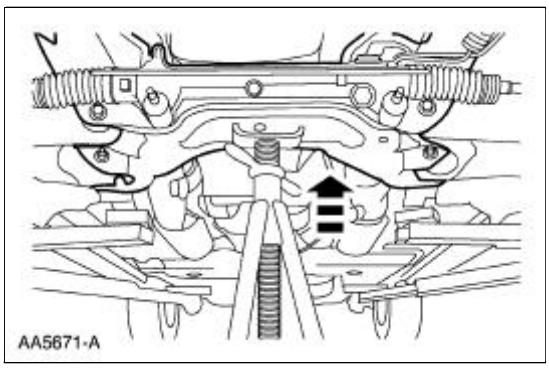
7. Position the starter wiring harness and install the wiring harness nuts.



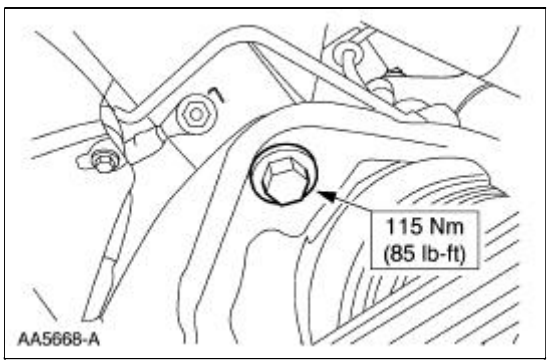
8. Install the sub-frame brace.



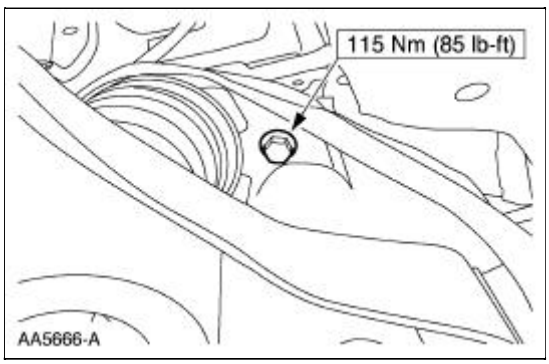
9. Raise the front sub-frame into position.



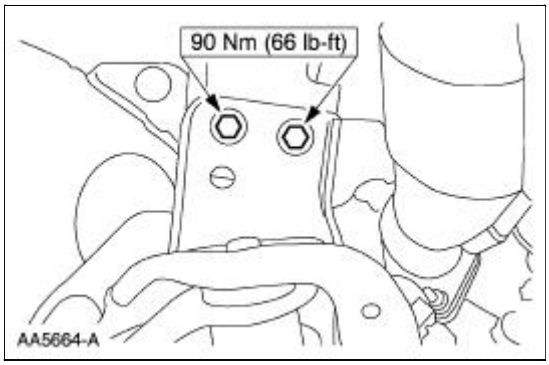
10. Install the two bolts.



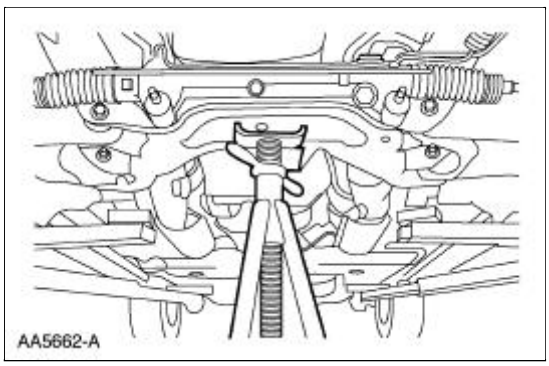
11. Install the two bolts.



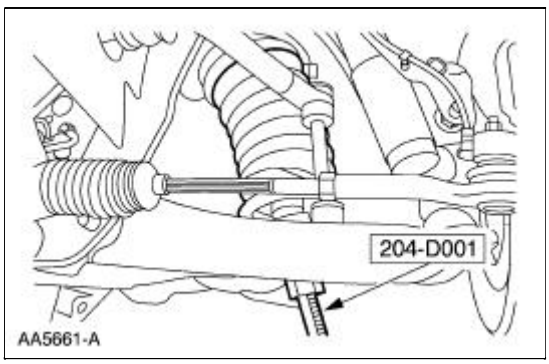
12. Install the four bolts.



13. Position the safety stand aside.

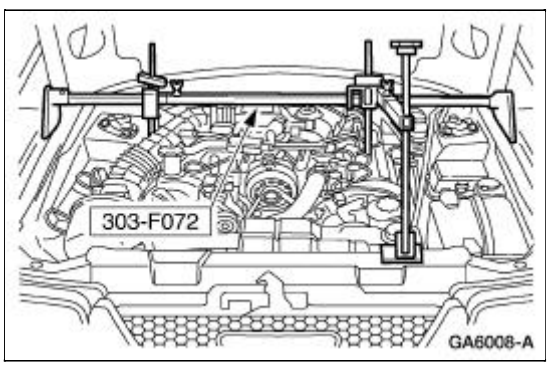


14. Release the tension from the front coil springs and remove the special tool.

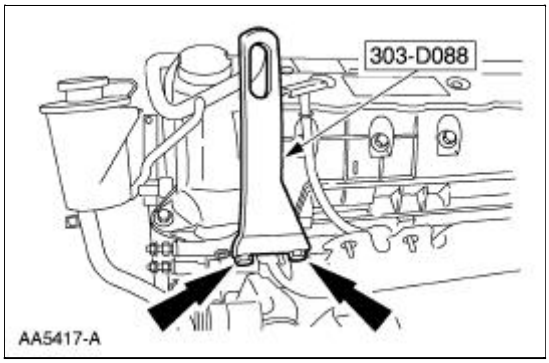


15. Raise the vehicle.

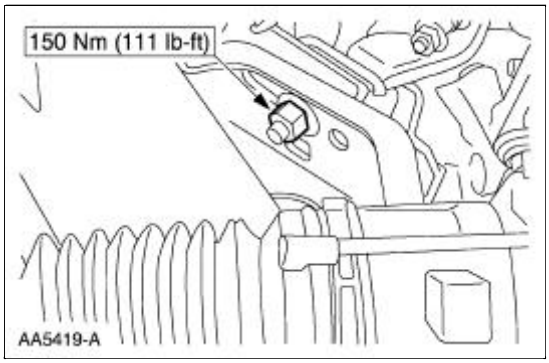
16. Using the special tool, lower the engine and remove the special tool.



17. Remove the special tools.



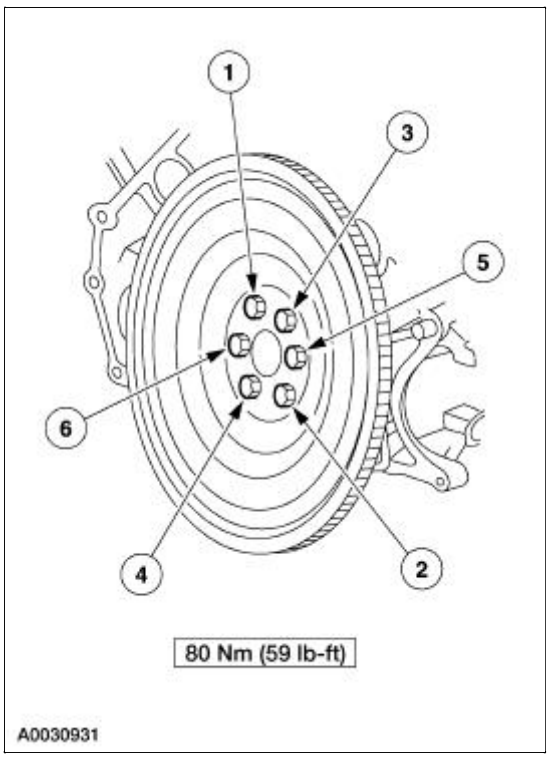
18. Install the two engine mount nuts.



19. Install the transmission. For additional information, refer to Section 307-01 or Section 308-03B .
20. Lower the vehicle.
21. Fill the engine crankcase with clean engine oil.
22. Install the A/C line. For additional information, refer to Section 412-03 .
23. Install the manifold and tube assembly—accumulator to compressor, 4.6L. For additional information, refer to Section 412-03 .
24. Install the radiator sight shield.
25. Install the air cleaner outlet tube. For additional information, refer to Section 303-12 .
26. Install the air intake scoop. For additional information, refer to Section 303-12 .
27. Install the battery ground cable. For additional information, refer to Section 414-01 .
28. Start the engine and check for leaks.

Flexplate

1. Remove the transmission. For additional information, refer to Section 307-01 .
2. Remove the bolts in the sequence shown, and remove the flexplate.

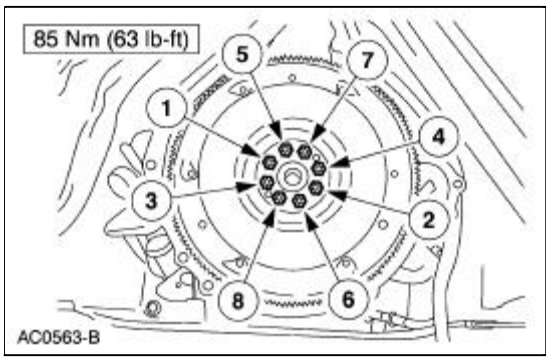


3. To install, reverse the removal procedure.

Flywheel

Removal

1. Remove the clutch components. For additional information, refer to Section 308-01 .
2. Remove the bolts and the flywheel.

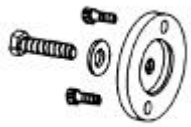
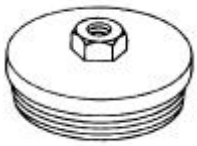
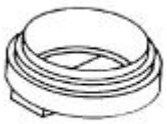


Installation

1. To install, reverse the removal procedure.

Crankshaft Rear Oil Seal

Special Tool(s)

 ST1480-A	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)
 ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
 ST1479-A	Installer, Crankshaft Rear Oil Seal 303-516 (T95P-6701-BH)
ST1481-A	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
ST1482-A	Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)
ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)

Material

Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Removal

Automatic transmission vehicles

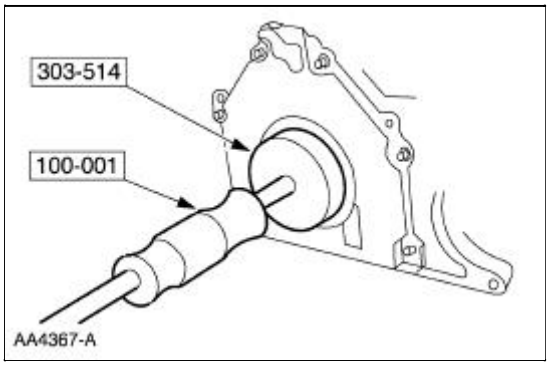
1. Remove the flexplate. For additional information, refer to Flexplate in this section.

Manual transmission vehicles

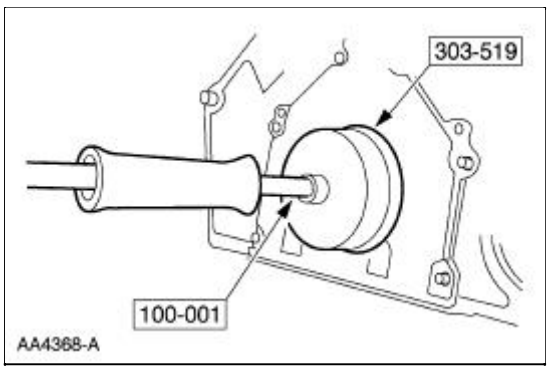
2. Remove the flywheel. For additional information, refer to Flywheel in this section.

All vehicles

3. Using the special tools, remove the crankshaft oil slinger.



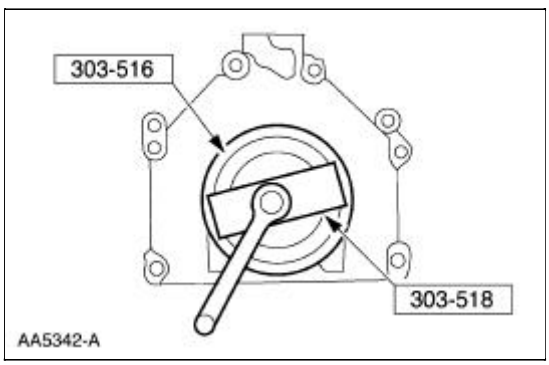
4. Using the special tools, remove the crankshaft rear oil seal.



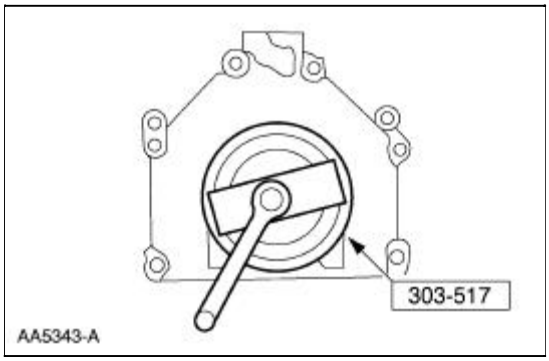
Installation

All vehicles

1. Using the special tools, install the crankshaft rear oil seal.
    - Lubricate the oil seal using clean engine oil.



2. Using the special tool, install the crankshaft oil slinger.



Manual transmission vehicles

3. Install the flywheel. For additional information, refer to Flywheel in this section.

Automatic transmission vehicles

4. Install the flexplate. For additional information, refer to Flexplate in this section.

Engine Mount

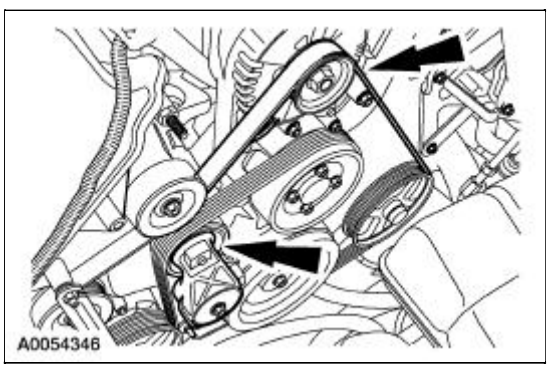
Special Tool(s)

ST2334-A	Support Bracket, Engine 303-639
ST2333-A	3-Bar Engine Support Kit 303-F072
ST2430-A	Alignment Tool, Subframe 502-004

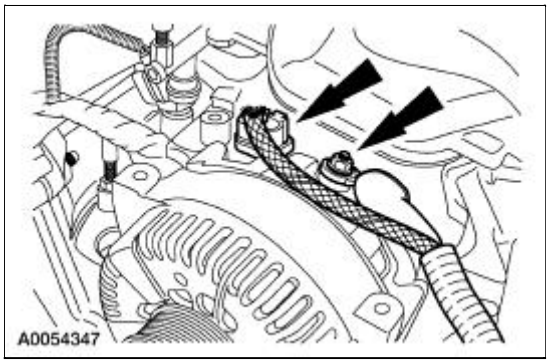
Removal

Both mounts

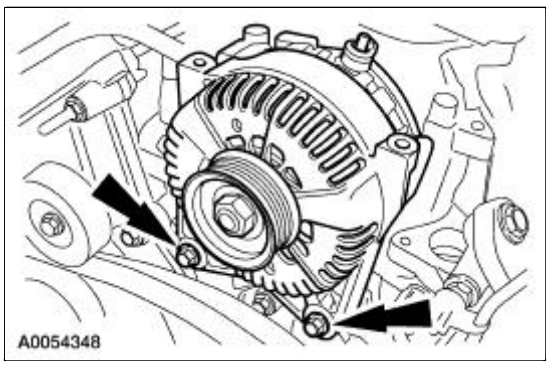
1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the coolant bypass tube. For additional information, refer to Section 303-03A .
3. Rotate the drive belt tensioner clockwise and detach the drive belt from the generator pulley.



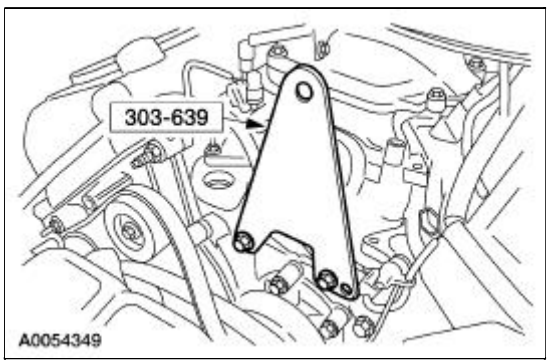
4. Disconnect the generator electrical connections.



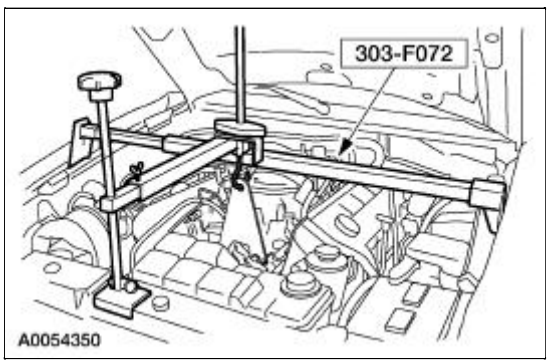
5. Remove the bolts and the generator.



6. Install the special tool.



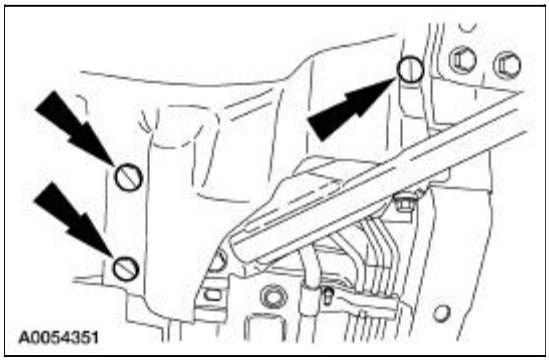
7. Using the special tool, support the engine.



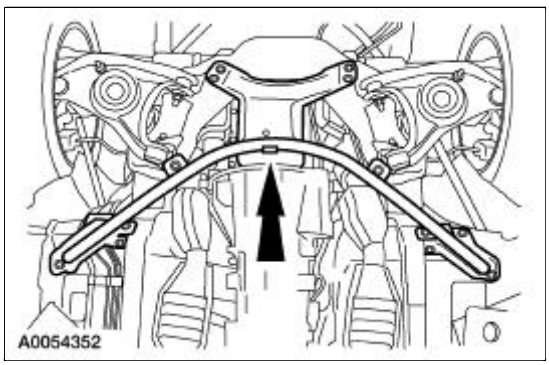
8. Remove the front springs. For additional information, refer to Section 204-01 .

9. **NOTE:** RH shown, LH similar.

Remove the six splash-shield pushpins.

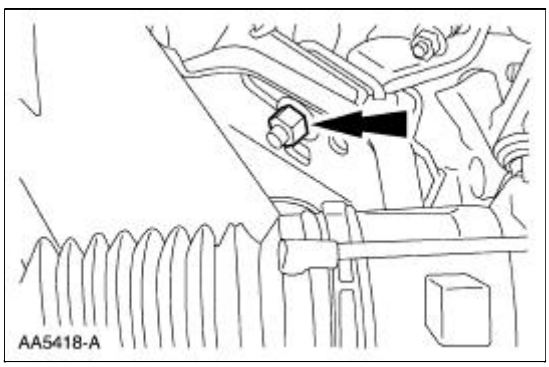


10. Remove the 13 bolts and the cross-brace support.

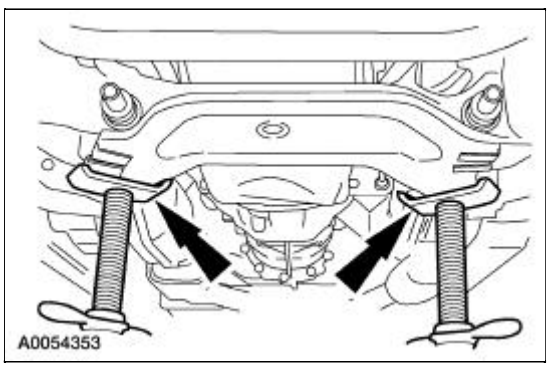


11. **NOTE:** RH shown, LH similar.

    Remove the two engine mount nuts.



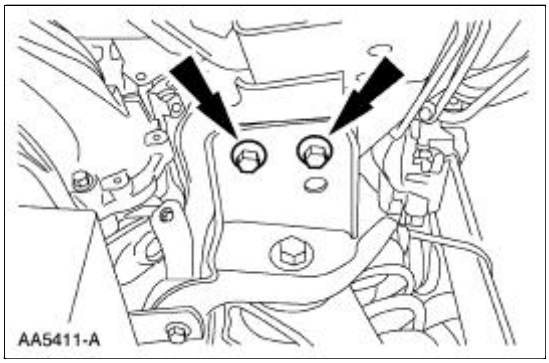
12. Using two jackstands, support the subframe.



13. **NOTE:** Mark the bolts and the crossmember location for assembly reference.

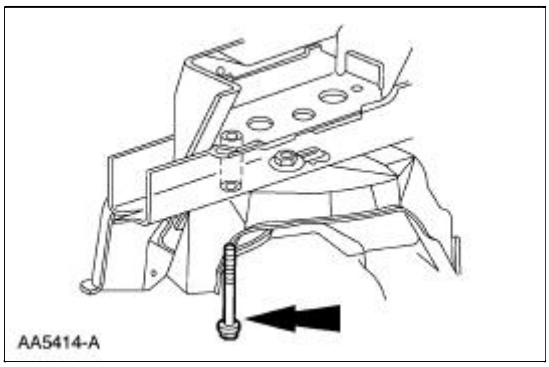
    NOTE: RH shown, LH similar.

    Remove the four bolts.



14. **NOTE:** RH shown, LH similar.

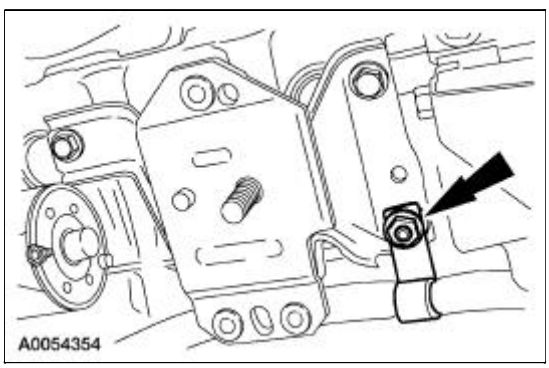
    Remove the four bolts.



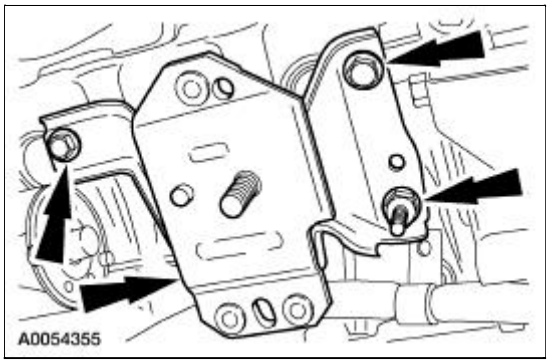
15. Using the jackstands, lower the front subframe.

RH mount

16. Remove the nut and detach the wiring harness.

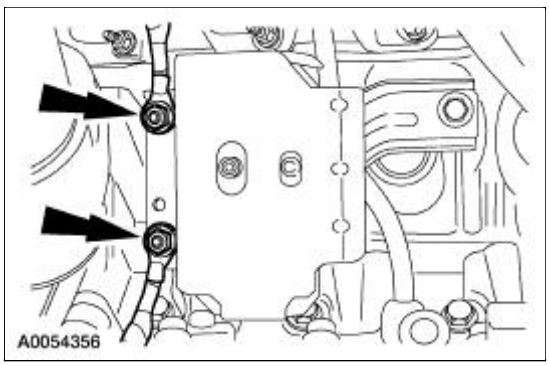


17. Remove the bolts, the studbolt and the engine mount.

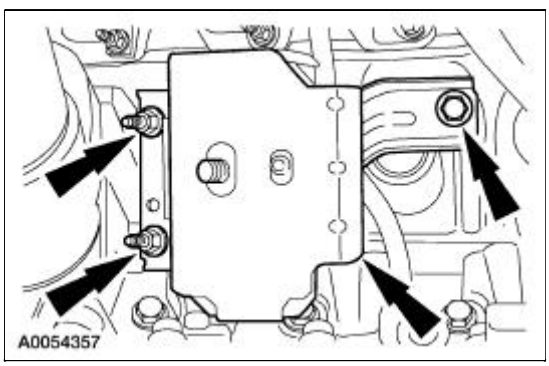


LH mount

18. Remove the nuts and detach the ground cables.



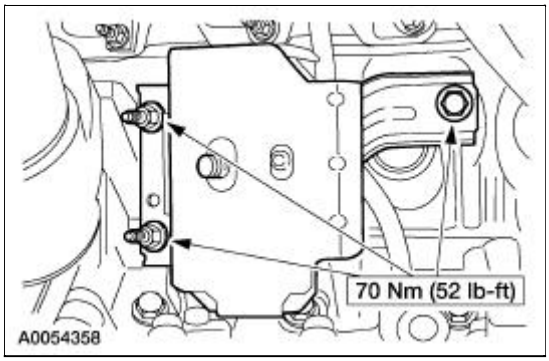
19. Remove the bolt, the studbolts and the engine mount.



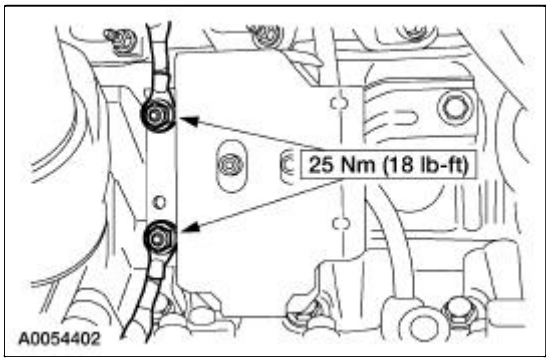
Installation

LH mount

1. Position the engine mount and install the bolt and studbolts.

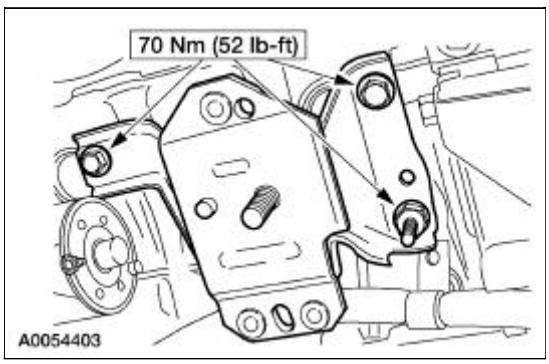


2. Attach the ground cables and install the nuts.

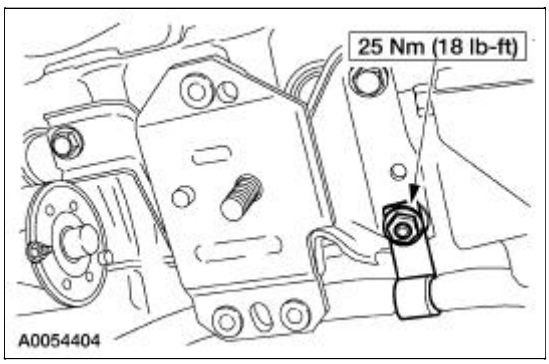


RH mount

3. Position the engine mount and install the bolts and studbolt.



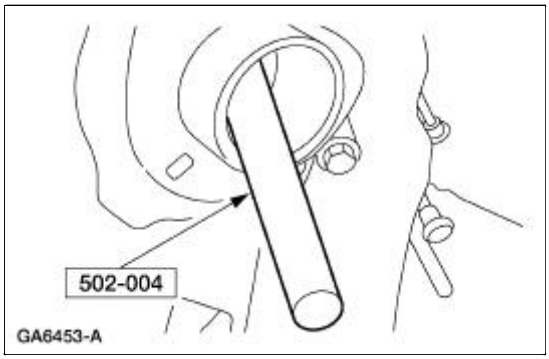
4. Attach the wiring harness and install the nut.



Both mounts

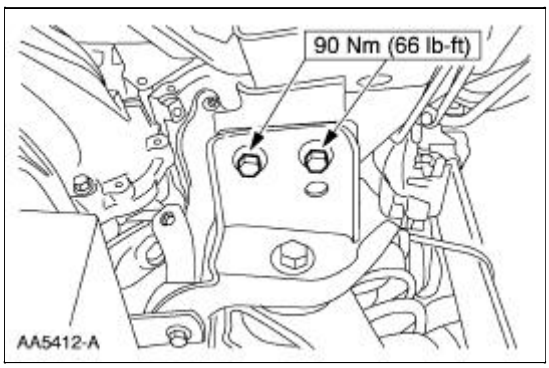
5. Using the jackstands, raise the subframe into position.
6. **NOTE:** RH shown, LH similar.

   Using the special tool, align the subframe.



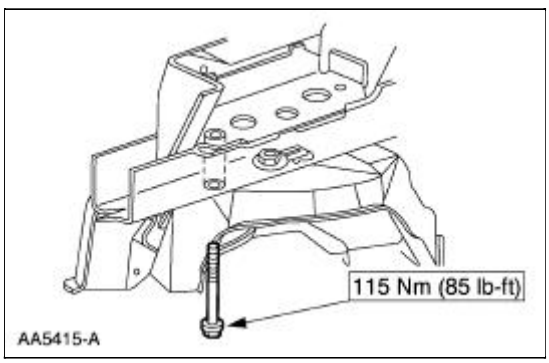
7. **NOTE:** RH shown, LH similar.

   Install the four bolts.

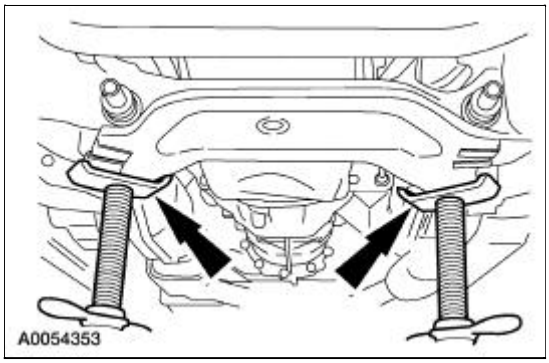


8. **NOTE:** RH shown, LH similar.

   Install the four bolts.

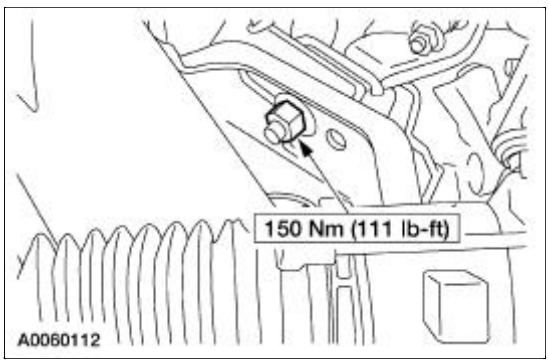


9. Remove the jackstands.

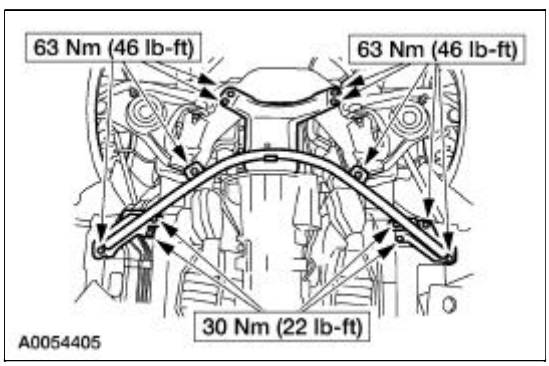


10. **NOTE:** RH shown, LH similar.

    Install the two engine mount nuts.

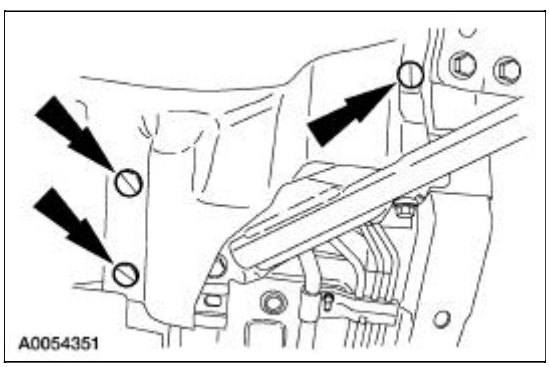


11. Position the cross-brace support and install the 13 bolts.



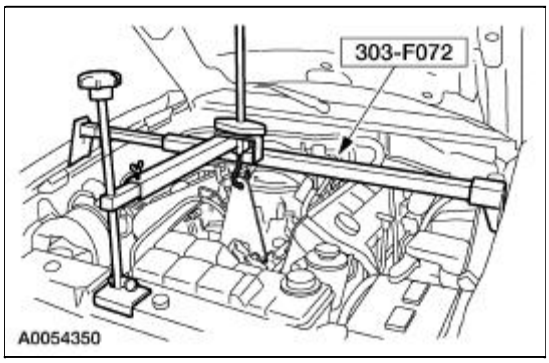
12. **NOTE:** RH shown, LH similar

    Install the six splash-shield pushpins.

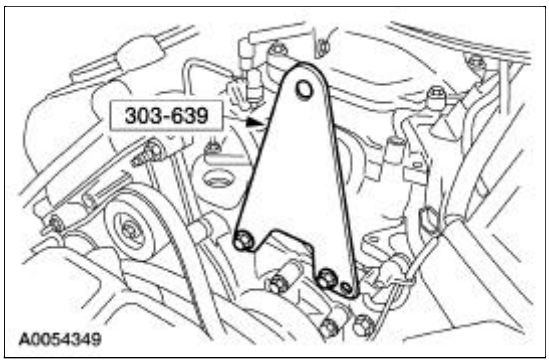


13. Install the front springs. For additional information, refer to Section 204-01 .

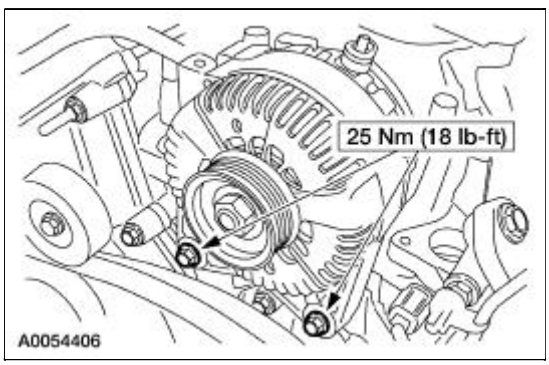
14. Remove the special tool.



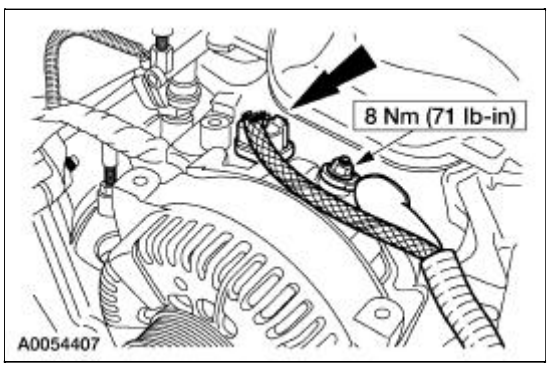
15. Remove the special tool.



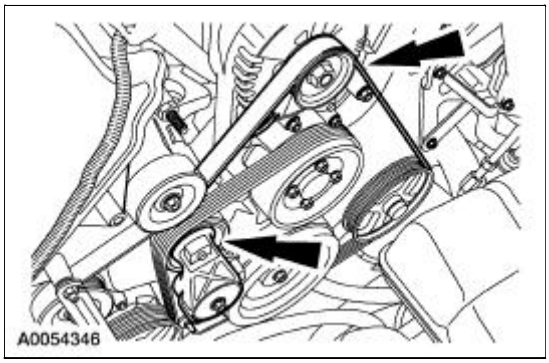
16. Position the generator and install the bolts.



17. Connect the generator electrical connections.



18. Rotate the drive belt tensioner clockwise and attach the drive belt to the generator pulley.
    - Make sure the drive belt is routed correctly and is aligned correctly installed on each pulley.

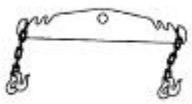


19. Connect the battery ground cable. For additional information, refer to Section 414-01 .

20. Install the coolant bypass tube. For additional information, refer to Section 303-03A .

Engine

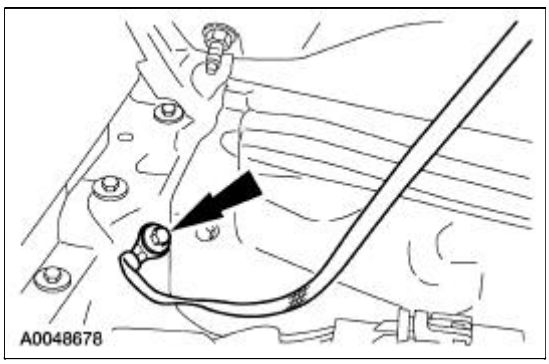
Special Tool(s)

ST1603-A	Lifting Bracket, Engine 303-D087 (D93P-6001-A1)
ST1604-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3)

Removal

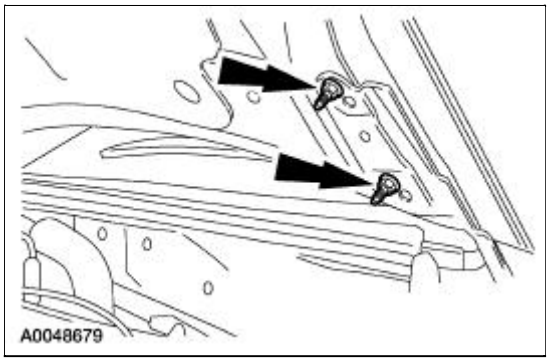
All vehicles

1. Disconnect the battery ground cable. For additional information, refer to Section 414-01 .
2. Remove the hood-to-body ground strap.



3. **NOTE:** Mark the hood hinge locations to aid in hood installation.

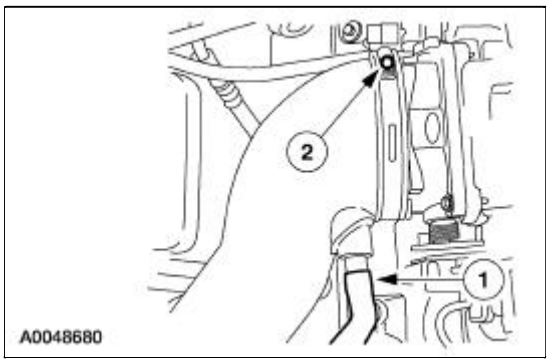
   Remove the four nuts and the hood.



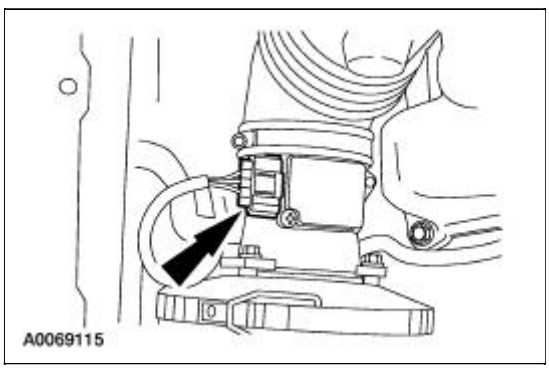
4. Recover the A/C system. For additional information, refer to Section 412-00 .

5. Remove the air intake scoop bracket. For additional information, refer to Section 303-12 .

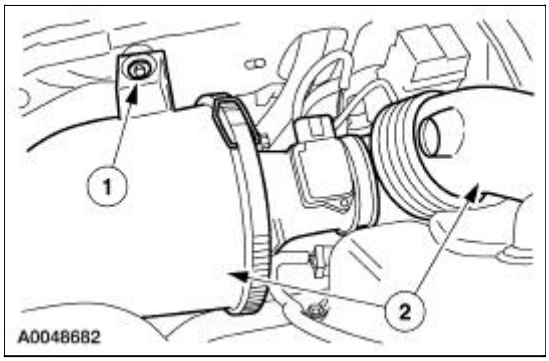
6. Disconnect the air cleaner outlet pipe at the throttle body.
    1. Disconnect the positive crankcase ventilation (PCV) inlet tube.
    2. Loosen the clamp and disconnect the outlet pipe.



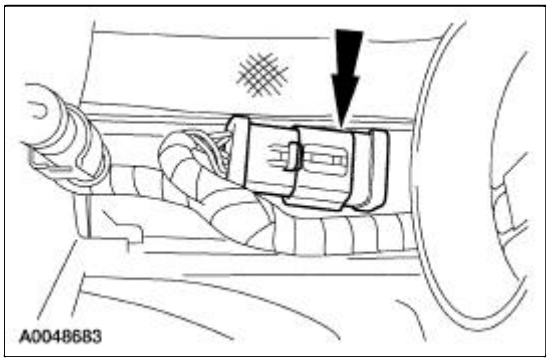
7. Disconnect the mass airflow sensor electrical connector.



8. Remove the air cleaner.
    1. Remove the bolt.
    2. Remove the air cleaner and the outlet pipe as an assembly.



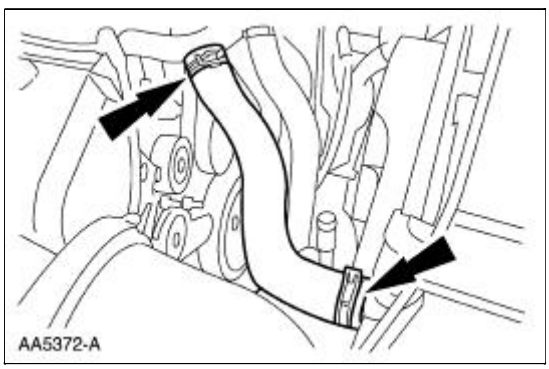
9. Disconnect the electrical connector.



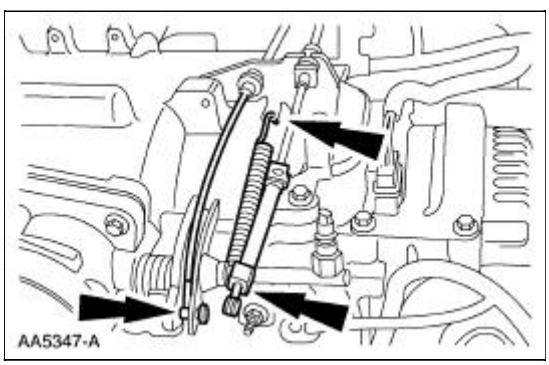
10. Drain the engine cooling system. For additional information, refer to Section 303-03A .

11. Disconnect the fuel tube spring lock coupling. For additional information, refer to Section 310-00 .

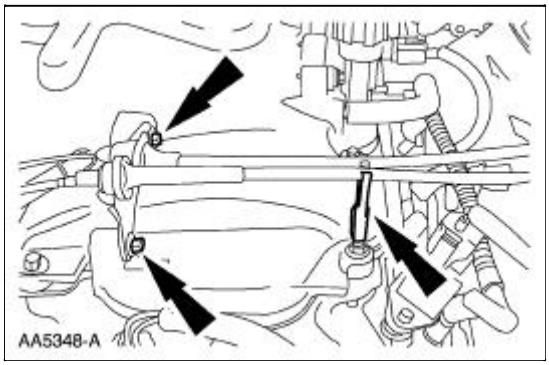
12. Remove the upper radiator hose (8260).



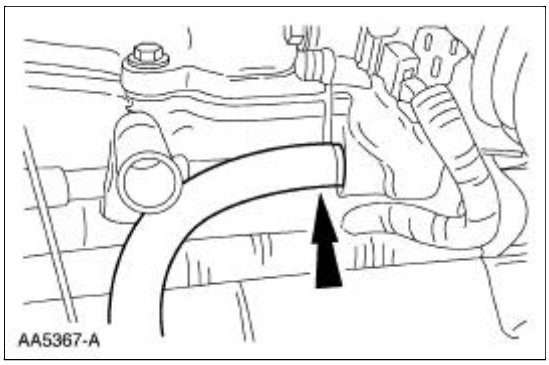
13. Disconnect the throttle cable, and the speed control cable, and remove the throttle return spring.



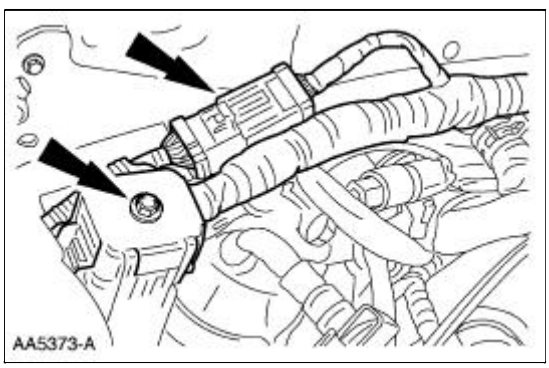
14. Remove the bolts and detach the retainer. Position the cables and the bracket aside.



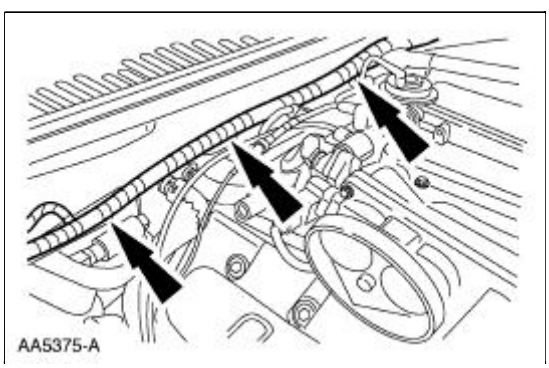
15. Disconnect the evaporative emissions return line.



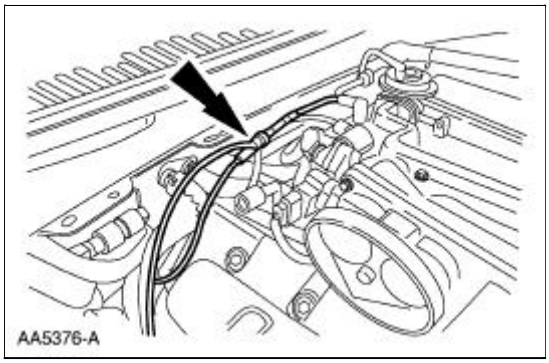
16. Disconnect the 16-pin and the 42-pin connectors.



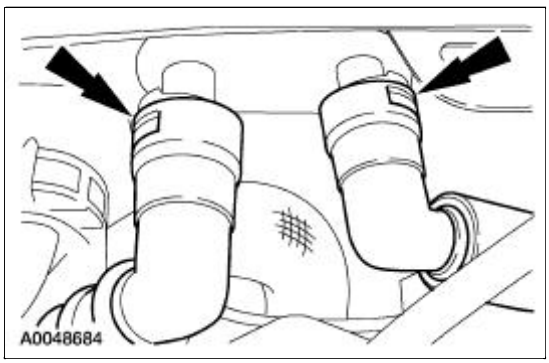
17. Separate the engine control sensor wiring in three locations and position onto the engine.



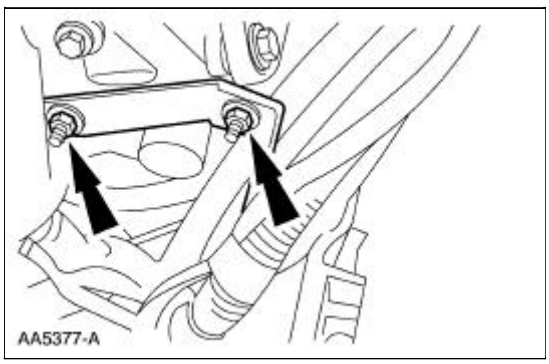
18. Disconnect the vacuum hoses.



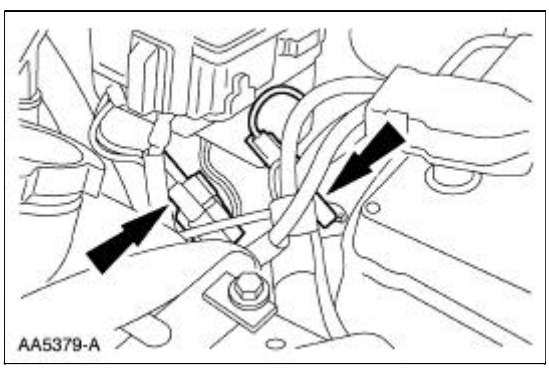
19. Disconnect the heater hoses.



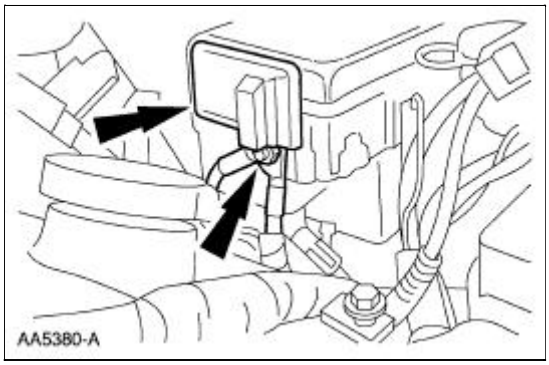
20. Remove the wiring support bracket.



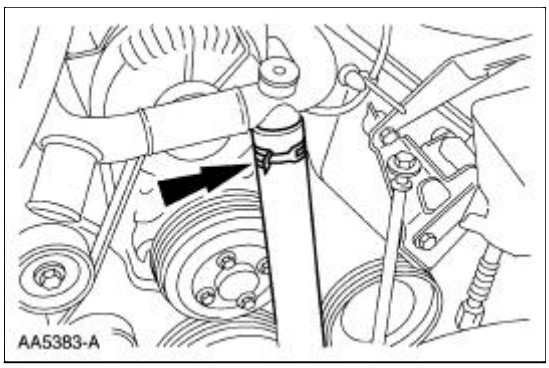
21. Disconnect the connectors.



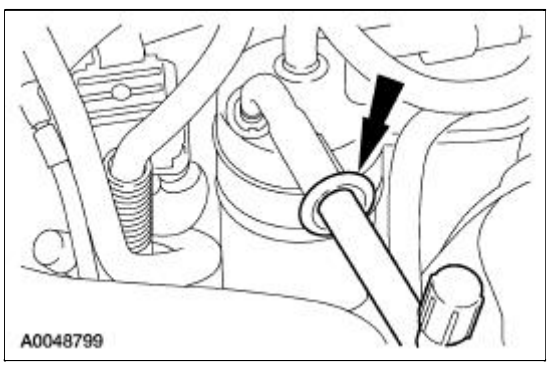
22. Raise the cover and remove the nut and cables.



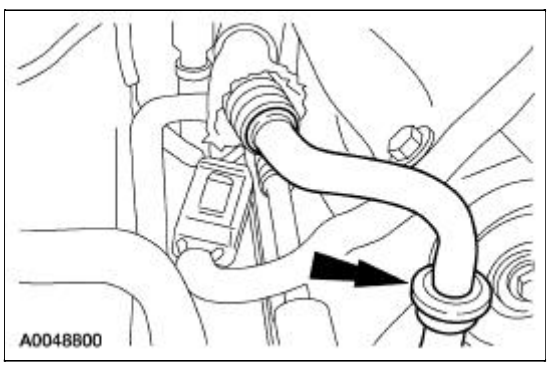
23. Disconnect the hose from the coolant bypass tube.



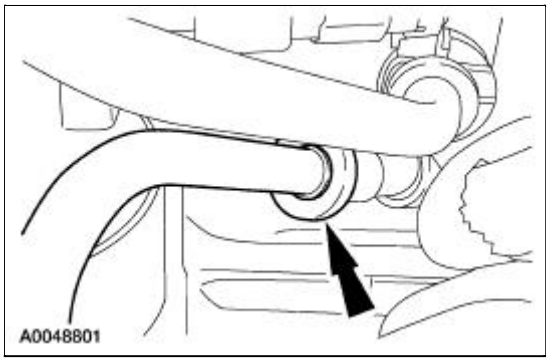
24. Disconnect the A/C suction tube from the accumulator.



25. Disconnect and remove the A/C suction tube.

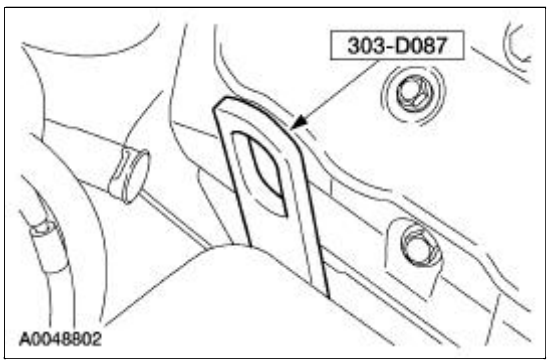


26. Disconnect the A/C tube. Position A/C tube aside.

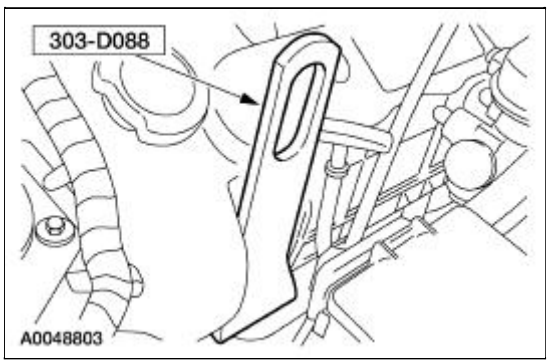


27. **NOTE:** The lifting bracket bolts will be installed when the vehicle is raised.

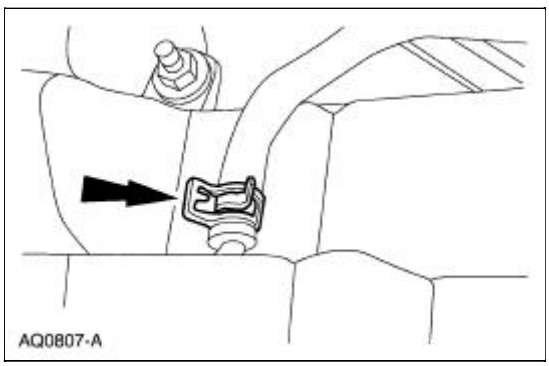
    Position the RH lifting bracket.



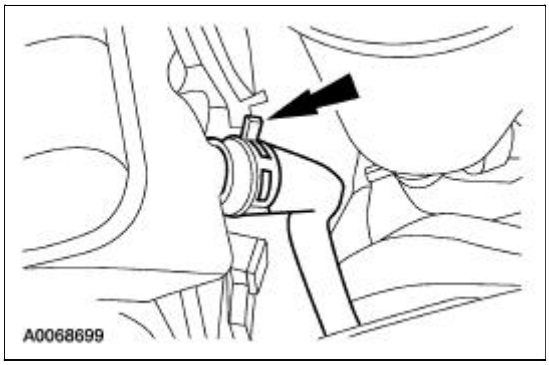
28. Install the LH lifting bracket.



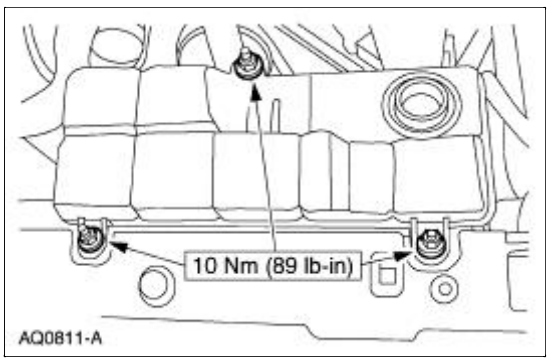
29. Disconnect the radiator vent hose from the degas bottle.



30. Remove the degas bottle return hose.



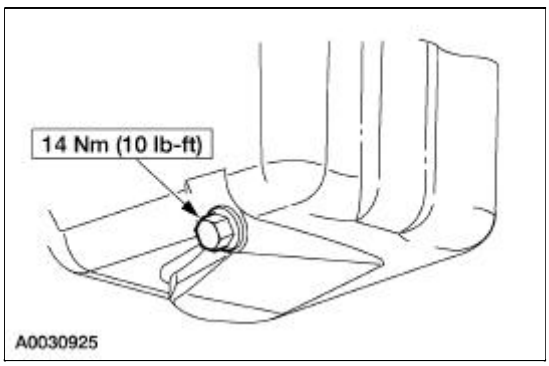
31. Remove the nuts and the degas bottle



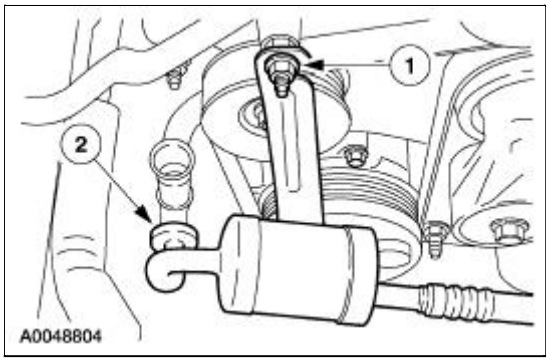
32. Remove the shifter. For additional information, refer to Section 307-01 or Section 308-03B .

33. Remove the dual converter H-pipe. For additional information, refer to Section 309-00 .

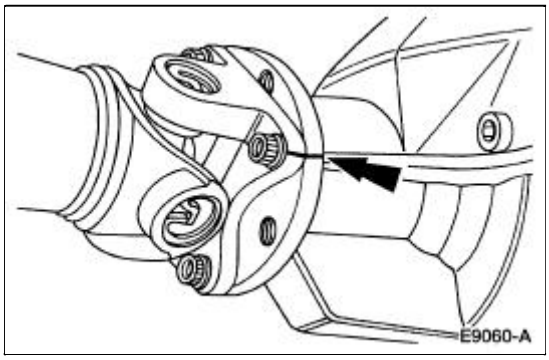
34. Drain the engine oil.
    - Install the drain plug when finished.



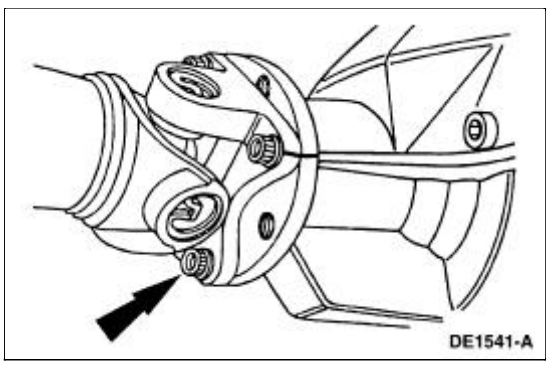
35. Position the A/C muffler aside.
    1. Remove the bracket retainer.
    2. Disconnect the A/C tube and position the A/C muffler aside.



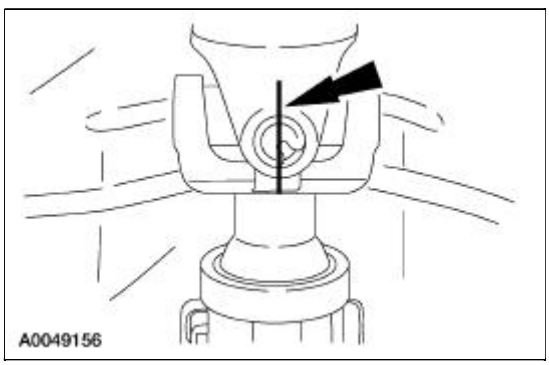
36. Index-mark the driveshaft flange and the rear axle pinion flange.



37. Remove the four bolts



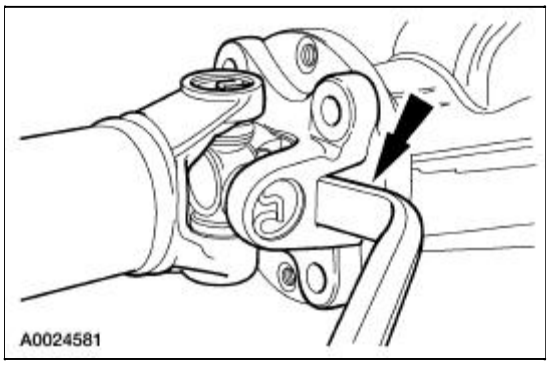
38. Index-mark the driveshaft at the six o'clock position.



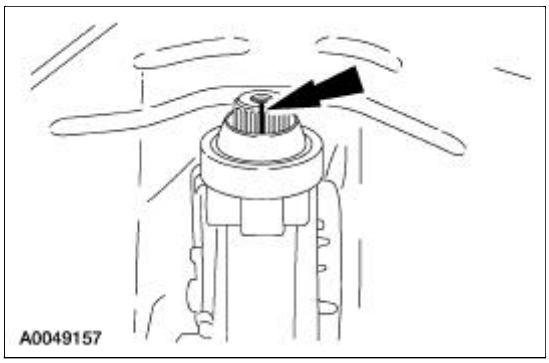
39. **CAUTION: the driveshaft flange fits tightly on the rear axle pinion flange pilot. Never hammer on the driveshaft or any of its components to disconnect the driveshaft flange from the pinion flange. Pry only in the area shown, with a suitable tool, to disconnect the driveshaft flange from the pinion flange.**

NOTE: Do not rotate the driveshaft.

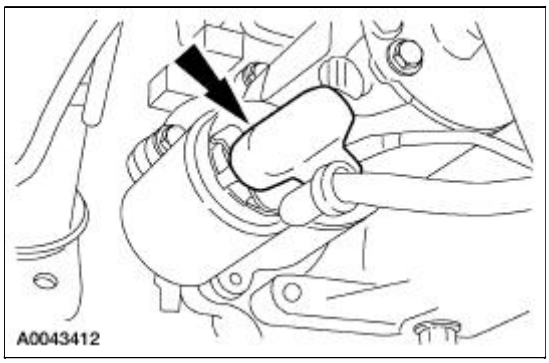
Using a suitable tool, disconnect the driveshaft flange from the rear axle flange and remove the driveshaft.



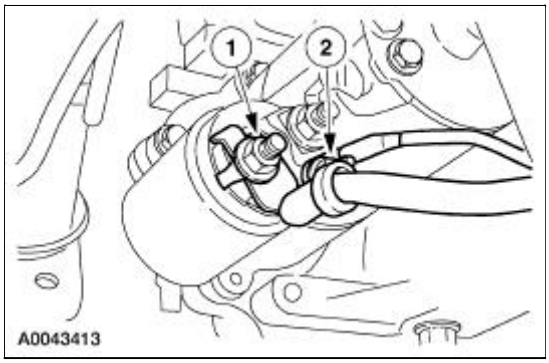
40. Index-mark the transmission output shaft at the six o'clock position.



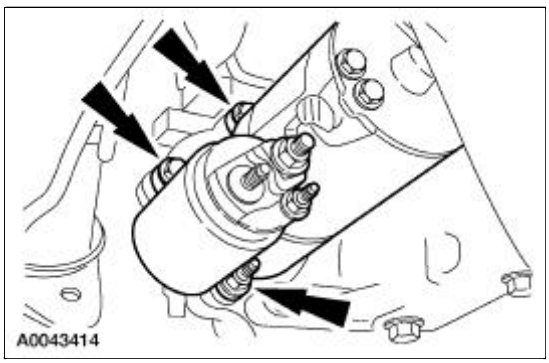
41. Remove the starter motor terminal cover.



42. Disconnect the starter wiring.
    1. Remove the nut and disconnect the battery positive cable.
    2. Remove the nut and disconnect the starter solenoid wire.

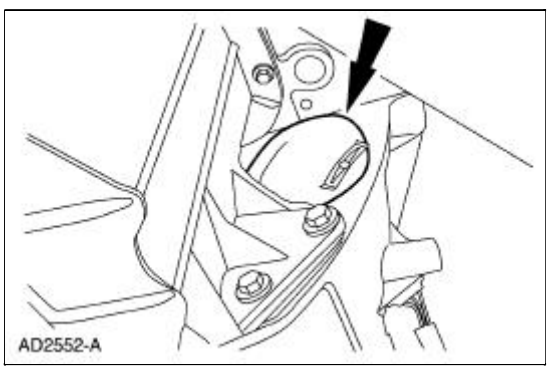


43. Remove the three bolts and the starter.

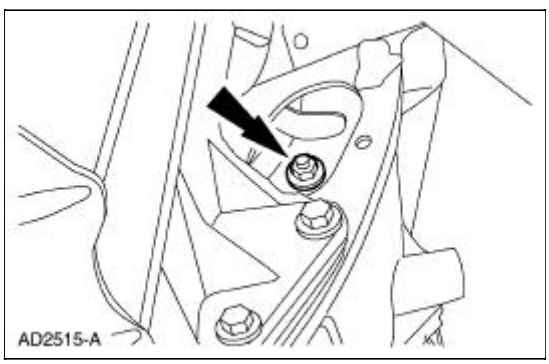


Automatic transmission vehicles

44. Remove the flywheel inspection cover.

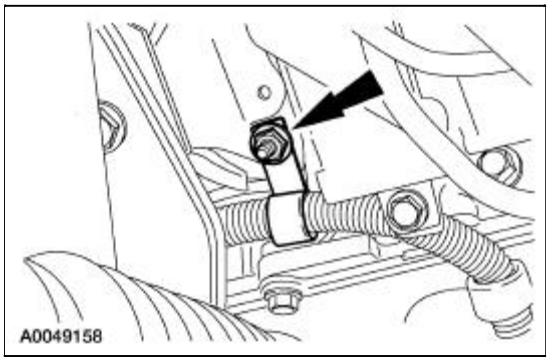


45. Remove the torque converter nuts.

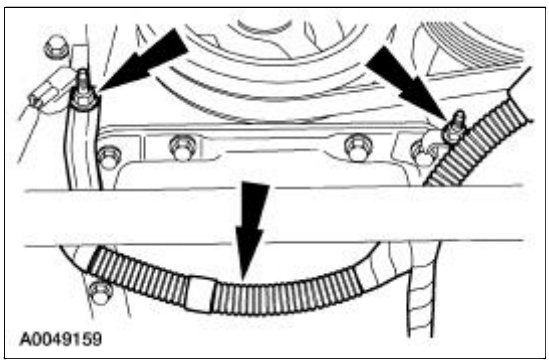


All vehicles

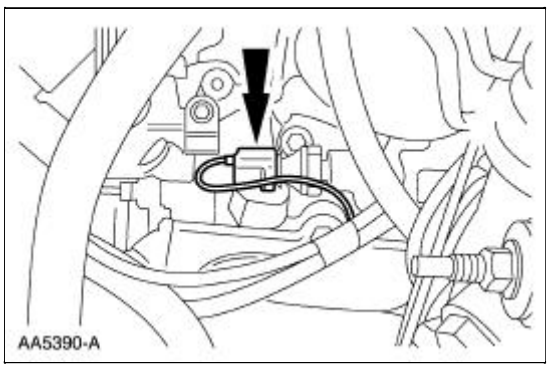
46. Remove the nut and the wiring harness bracket.



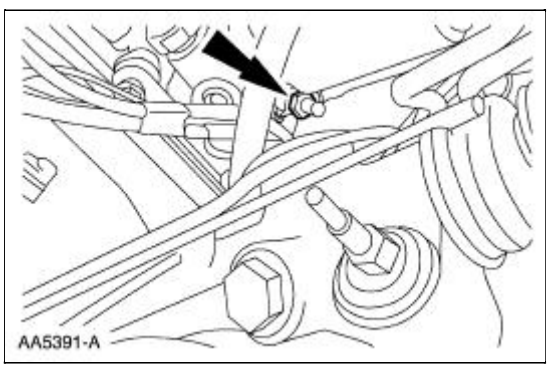
47. Remove the nuts and position the wiring harness aside.



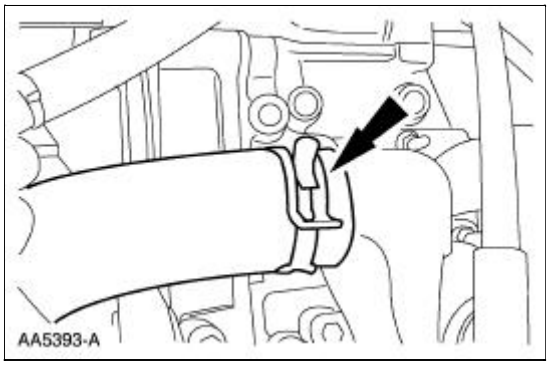
48. Disconnect the oil pressure sensor.



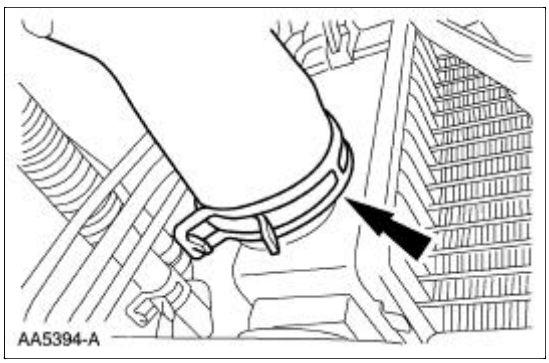
49. Remove the nut and the engine ground cable.



50. Disconnect the hose from the oil filter adapter.

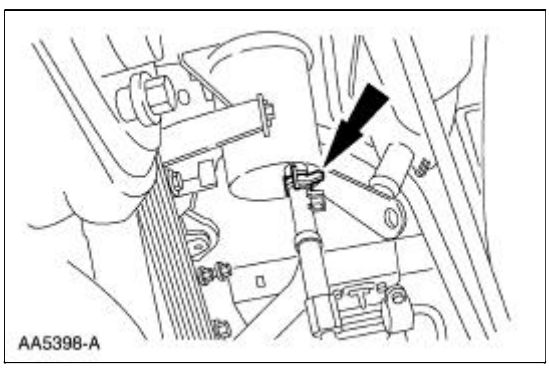


51. Disconnect and remove the lower hose from the radiator.

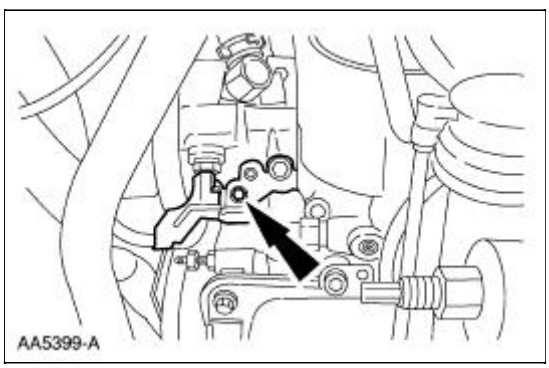


52. **NOTE:** Drain the power steering fluid into a suitable container.

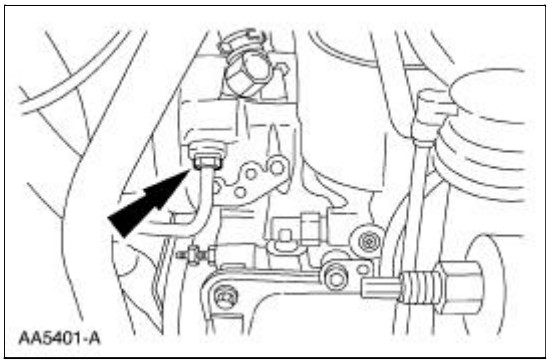
    Disconnect the hose from the power steering reservoir.



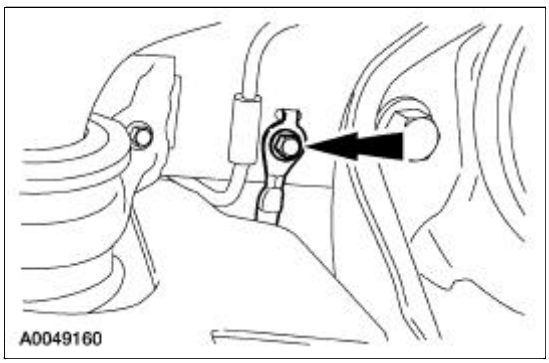
53. Remove the bolt and the anti-rotation clip.



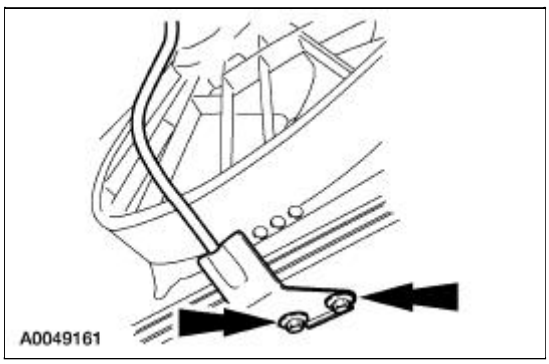
54. Loosen the fitting and disconnect the high pressure hose from the power steering pump.



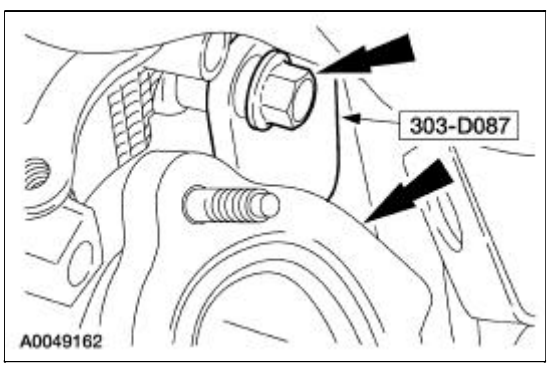
55. Remove the ground strap bolt.



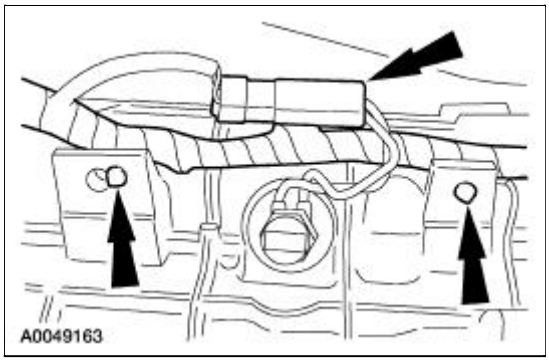
56. Remove the degas bottle support bracket.



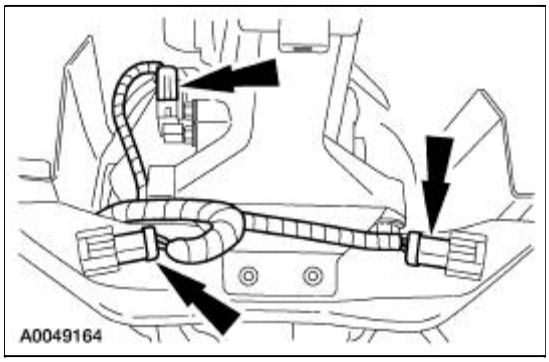
57. Install the two bolts from the RH lifting bracket.



58. Disconnect the reversing lamp switch electrical connector, and the wiring harness from the transmission.

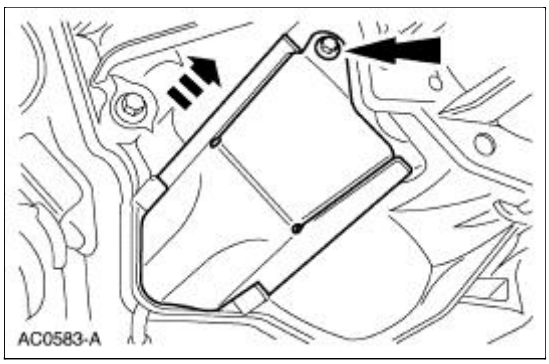


59. Disconnect the output shaft speed (OSS) sensor electrical connector and detach the left and right oxygen sensor electrical connectors from the crossmember.



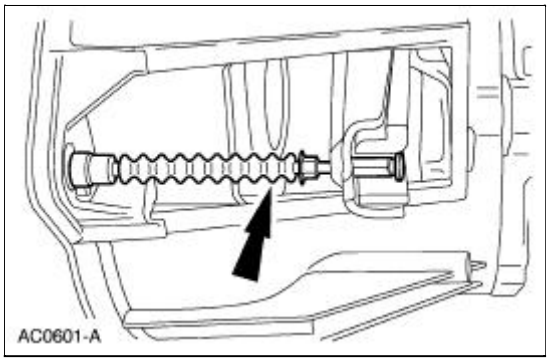
Manual transmission vehicles

60. Remove the bolt and the clutch release lever cover.

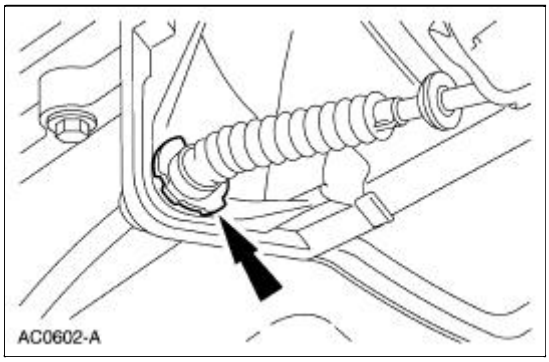


61. **CAUTION: To prevent component damage, do not depress the clutch pedal with the transmission removed.**

    Detach the clutch release cable from the clutch release fork.

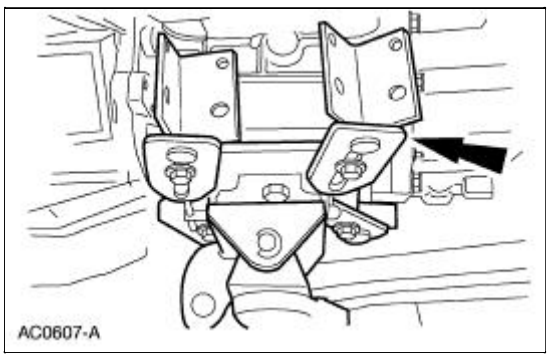


62. Remove the clutch cable retainer and remove the clutch cable from the transmission.

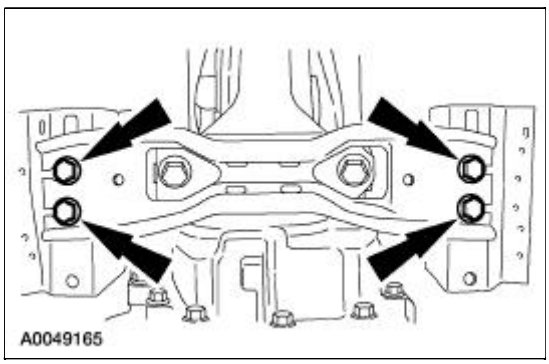


All vehicles

63. Position a transmission jack and support the transmission.

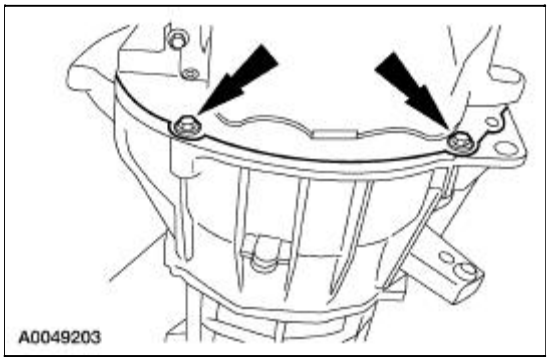


64. Remove the transmission crossmember bolts.



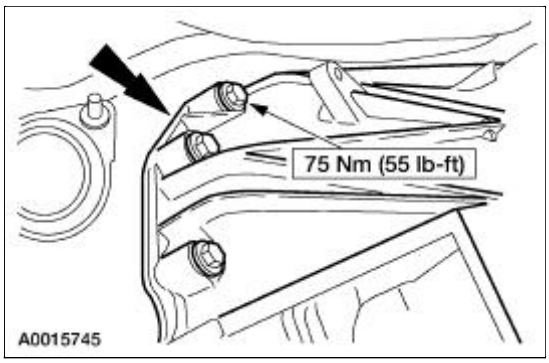
Automatic transmission vehicles

65. Remove the bolts.



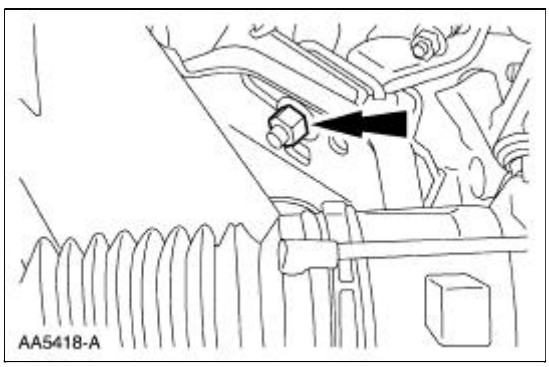
All vehicles

66. Lower the transmission, remove the seven bolts, and remove the transmission.

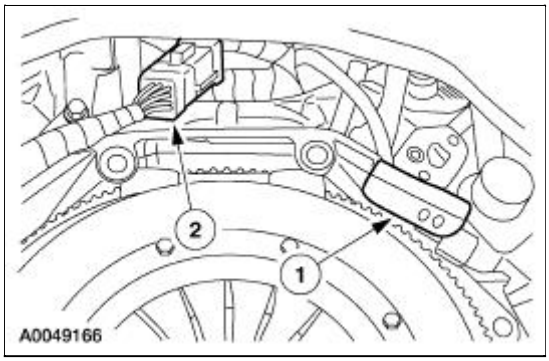


67. **NOTE:** RH side shown, LH side similar.

    Remove the two engine mount nuts.



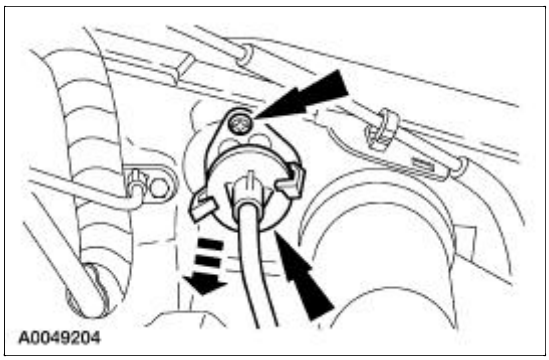
68. Remove the transmission wiring harness.
    1. Remove the RH oxygen sensor connector from the bracket.
    2. Disconnect the transmission wiring connector and remove the harness.



69. Lower the vehicle.

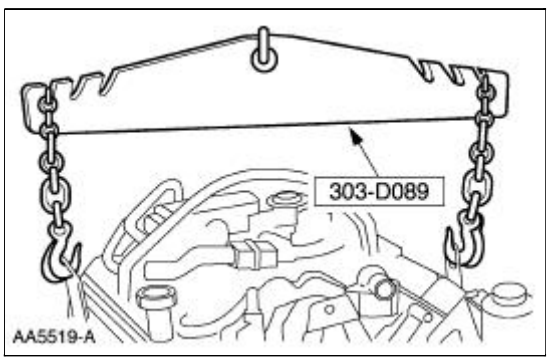
Manual transmission vehicles

70. Remove the two screws and position the clutch cable aside.



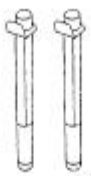
All vehicles

71. Attach the special tool to a floor crane and the engine, and remove the engine from the vehicle.



Engine

Special Tool(s)

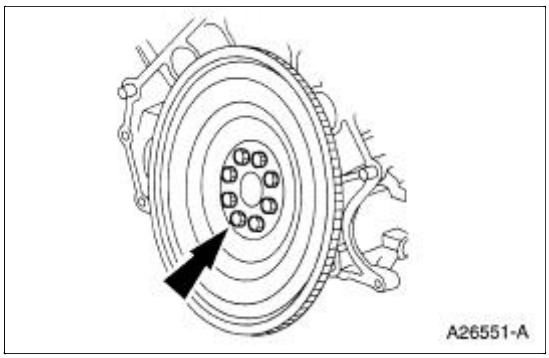
ST1185-A	Impact Slide Hammer 100-001 (T50T-100-A)
ST1286-A	Remover, Crankshaft Vibration Damper 303-009 (T58P-6316-D)
ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)
 ST1337-A	Guides, Connecting Rod 303-442 (T93P-6136-A)
ST1382-A	Remover, Crankshaft Rear Oil Seal 303-519 (T95P-6701-EH)
ST1481-A	Remover, Crankshaft Rear Oil Slinger 303-514 (T95P-6701-AH)
ST1718-A	Compressor, Valve Spring (Intake) 303-452 (T93P-6565-AR)
	Compressor, Valve Spring (Exhaust)

 ST1693-A	303-567 (T97P-6565-AH)
 ST1730-A	Remover, Crankshaft Front Oil Seal 303-107 (T74P-6700-A)

Disassembly

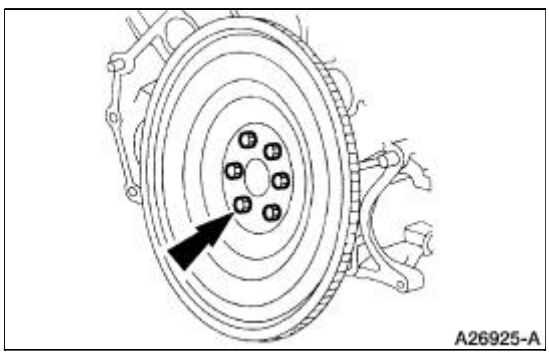
Manual transmission vehicles

1. Remove the clutch and pressure plate. For additional information, refer to Section 308-02 .
2. Remove the flywheel.



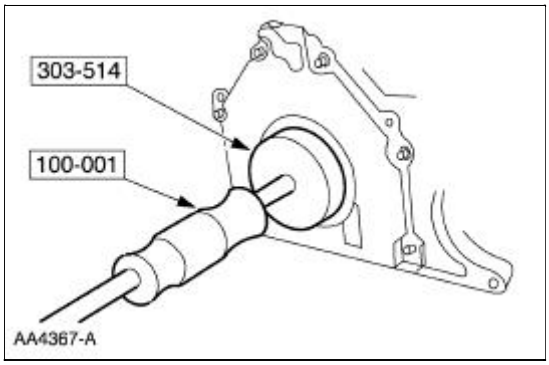
Automatic transmission vehicles

3. Remove the flexplate. For additional information, refer to Flexplate in this section.

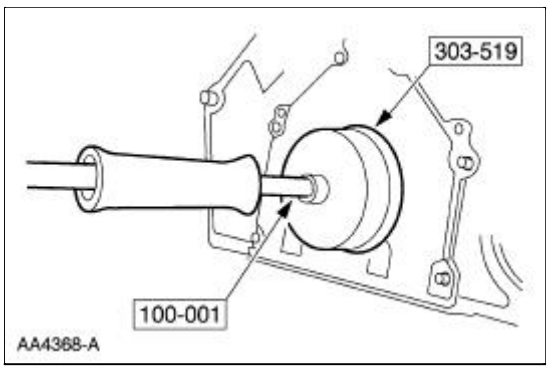


All vehicles

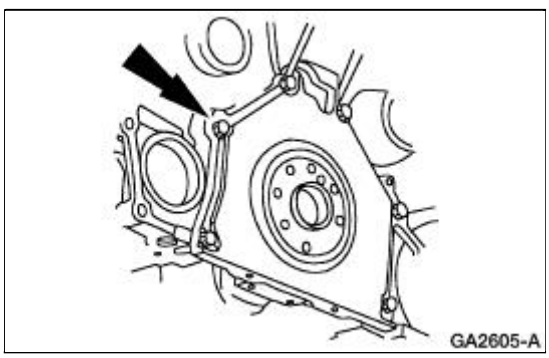
4. Using the special tool, remove the rear oil slinger.



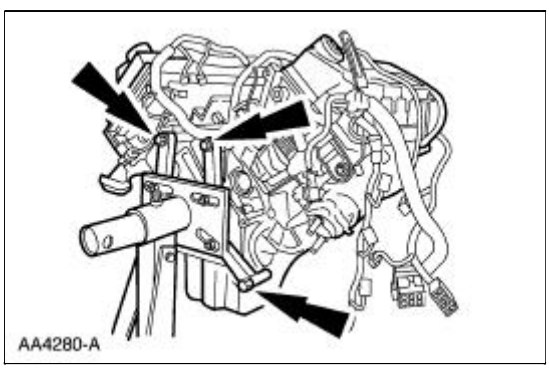
5. Using the special tool, remove the rear main seal.



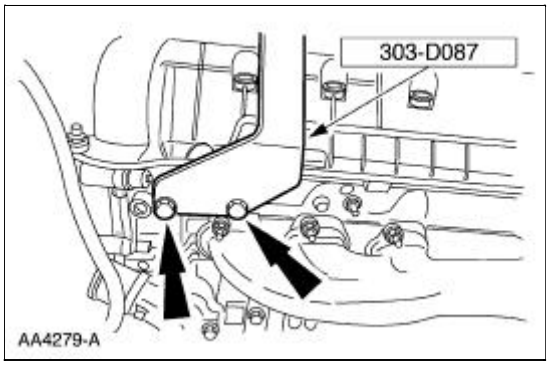
6. Remove the rear seal retainer plate.



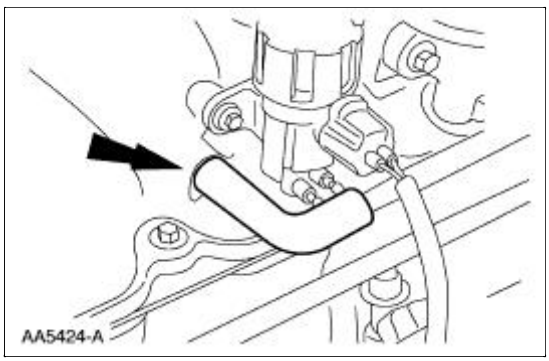
7. Mount the engine on a work stand.



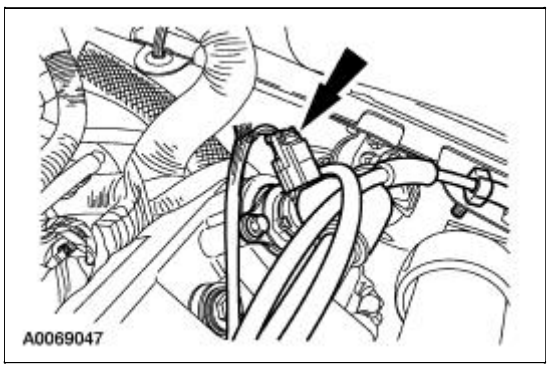
8. Remove the special tools.



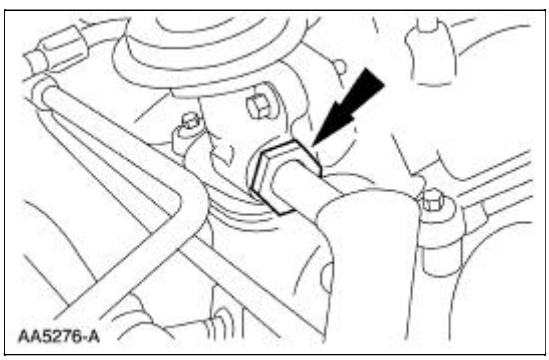
9. Disconnect the positive crankcase ventilation (PCV) tube.



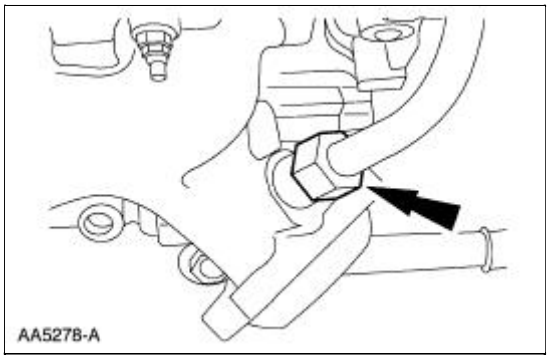
10. Remove the PCV valve tube and electrical connector.



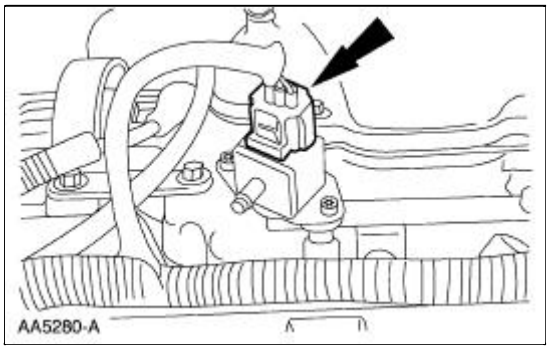
11. Disconnect the exhaust gas recirculation (EGR) tube from the EGR valve.



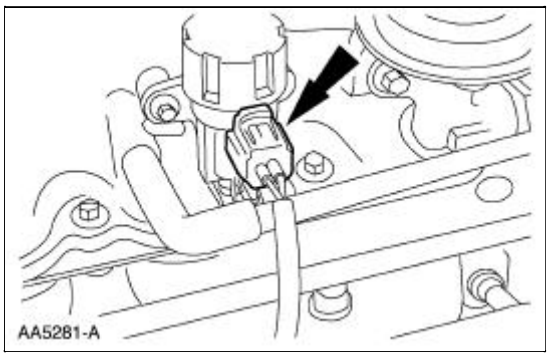
12. Disconnect the EGR tube from the exhaust manifold.



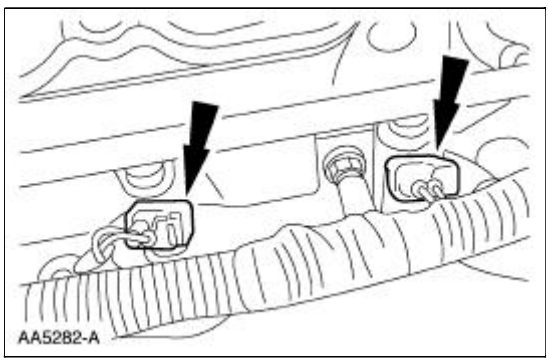
13. Disconnect the fuel pressure damper electrical connector.



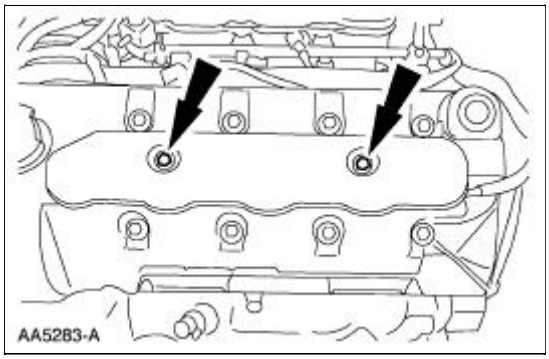
14. Disconnect the EGR vacuum regulator electrical connector.



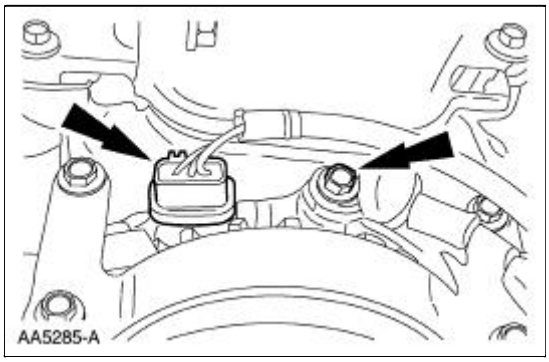
15. Disconnect the four LH fuel injector electrical connectors.



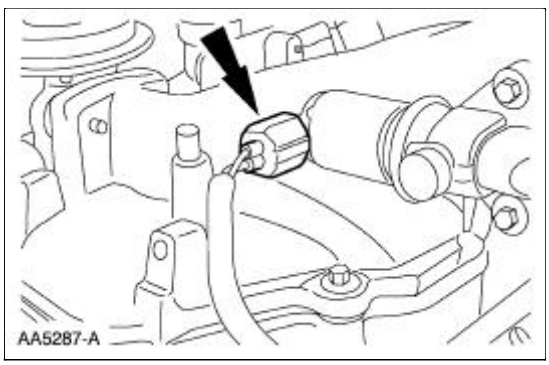
16. Remove the LH coil cover.



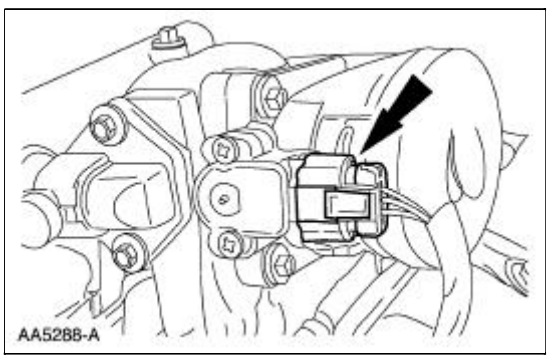
17. Disconnect the generator.



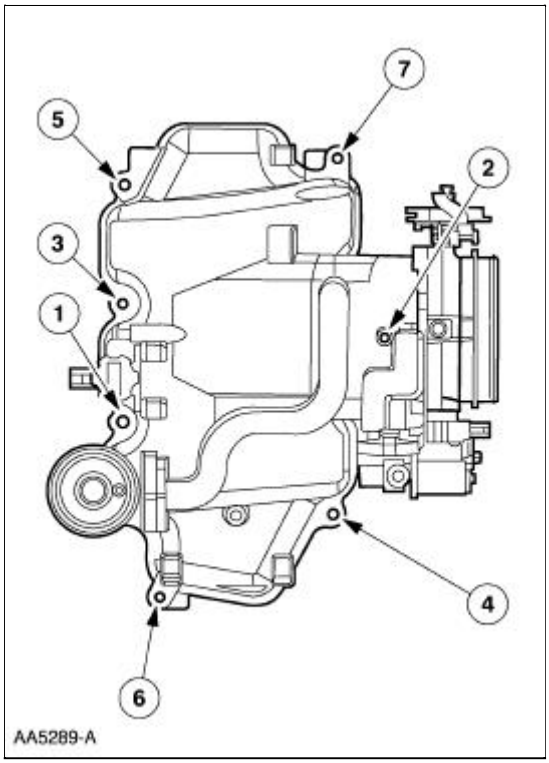
18. Disconnect the idle air control (IAC) valve electrical connector.



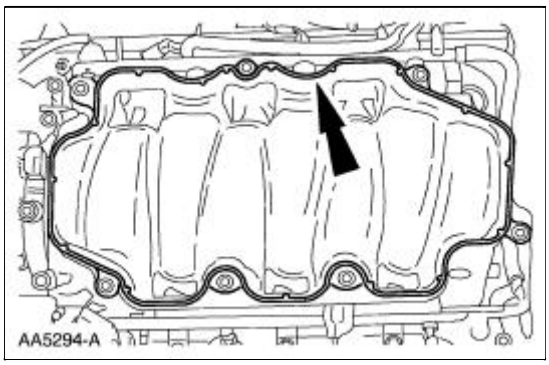
19. Disconnect the throttle position (TP) sensor electrical connector.



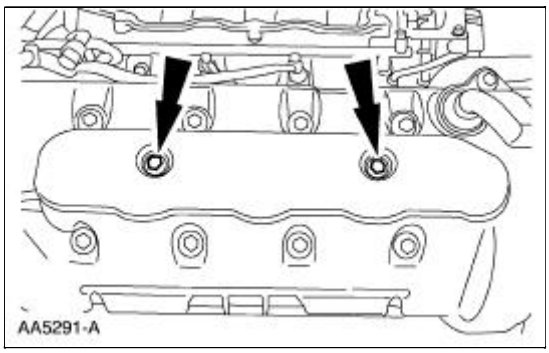
20. Remove the bolts and the upper intake manifold.



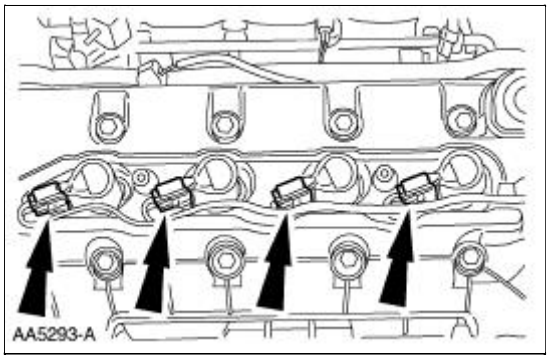
21. Remove the upper intake manifold gasket.
    - Clean and inspect the sealing surfaces.



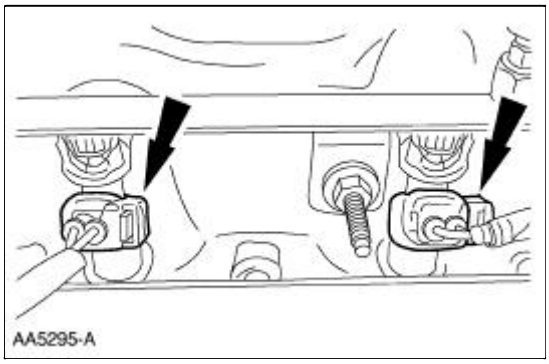
22. Remove the RH coil cover.



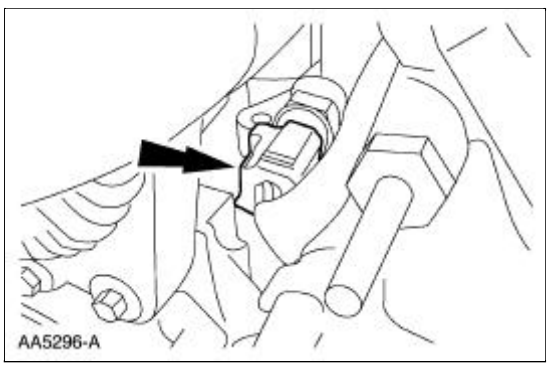
23. Disconnect the LH ignition coils.



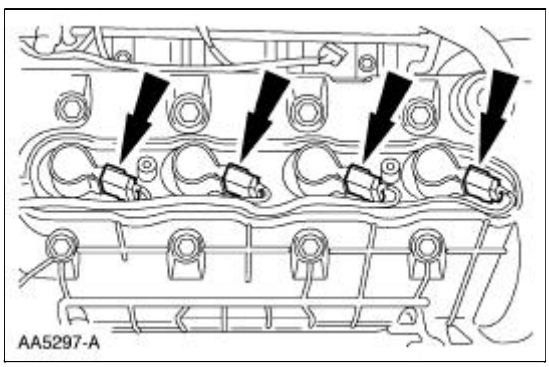
24. Disconnect the four RH fuel injector electrical connectors.



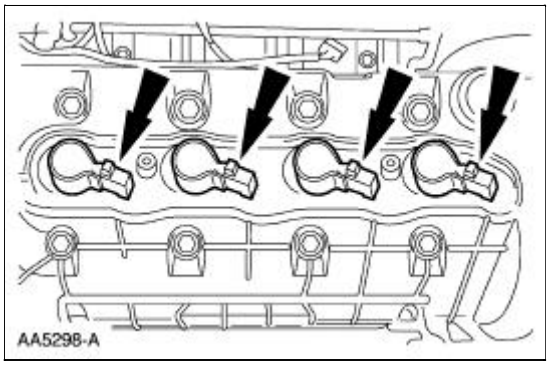
25. Disconnect the engine coolant temperature (ECT) sensor.



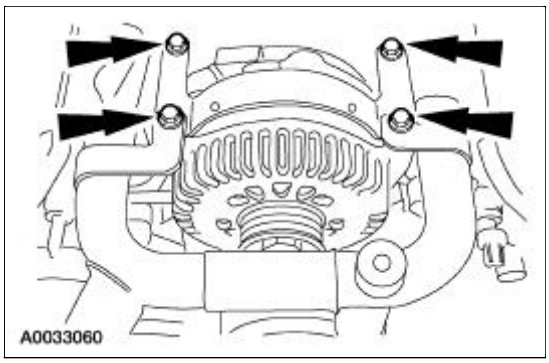
26. Disconnect the RH ignition coils.



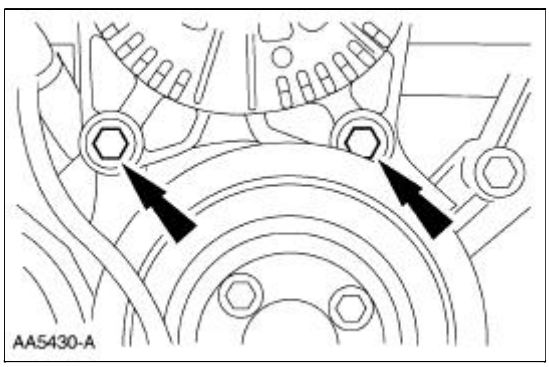
27. Remove the eight ignition coils.



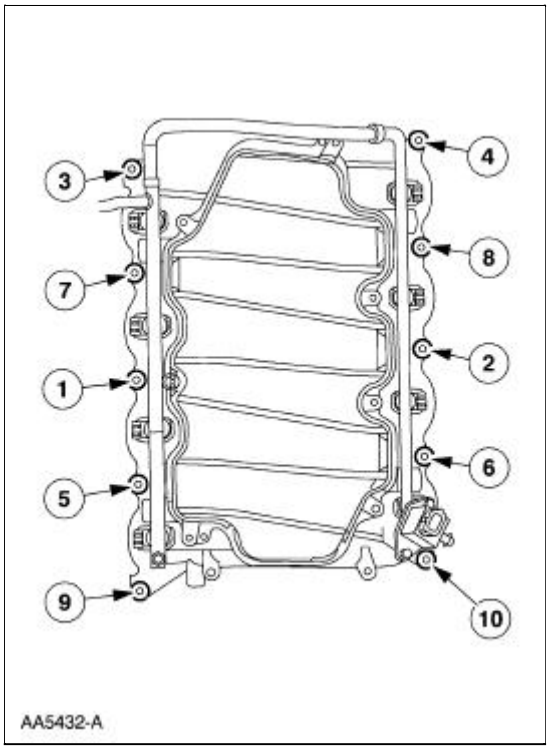
28. Remove the bracket from the accessory drive belt tensioner.
29. Remove the accessory drive belt.
30. Remove the coolant bypass tube and upper generator support bracket.
    - Remove the bolts.
    - Remove the coolant bypass tube.
    - Remove the upper generator support bracket.



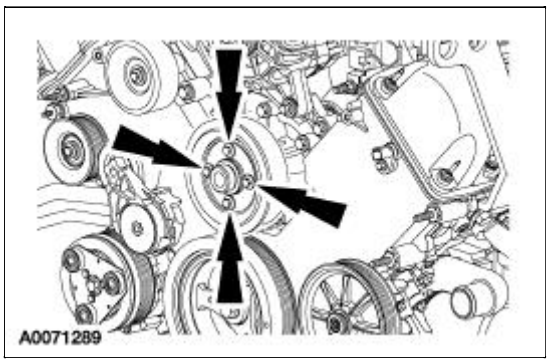
31. Remove the generator.



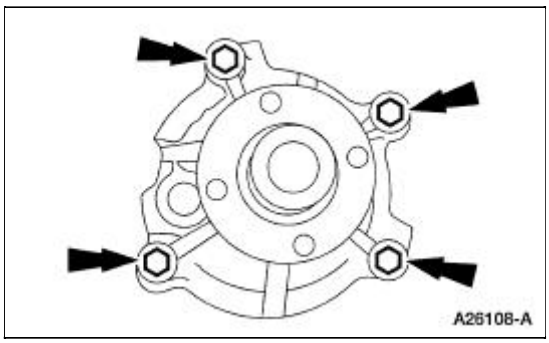
32. Remove the eight bolts and the two studs in the sequence shown. Remove the lower intake manifold.



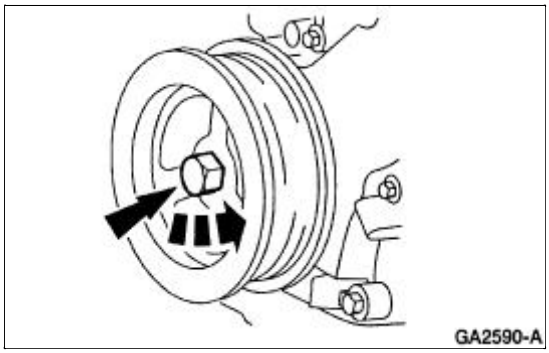
33. Remove the bolts and the coolant pump pulley.



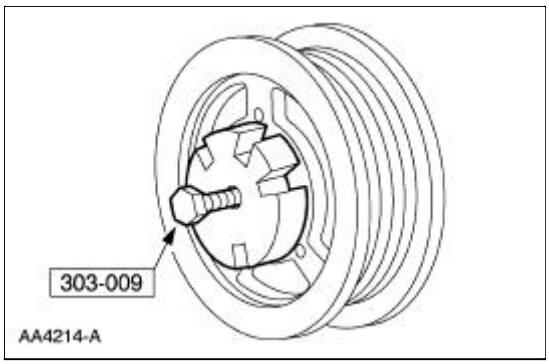
34. Remove the coolant pump from the cylinder block.
    - Remove the bolts.
    - Inspect and clean the sealing surfaces.



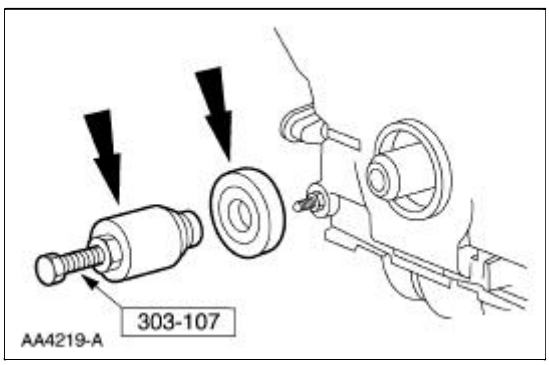
35. Remove the bolt.



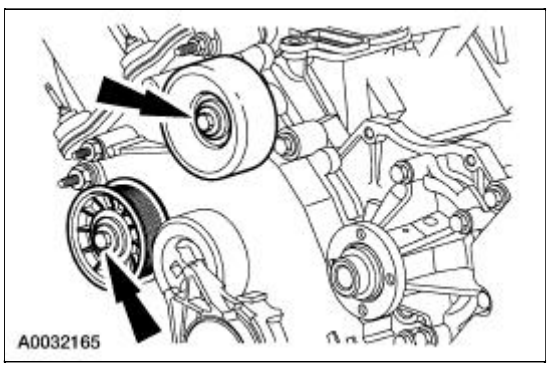
36. Using the special tool, remove the crankshaft pulley.



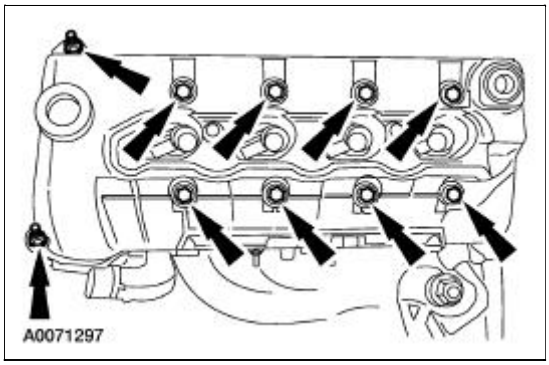
37. Using the special tool, remove the crankshaft front seal.



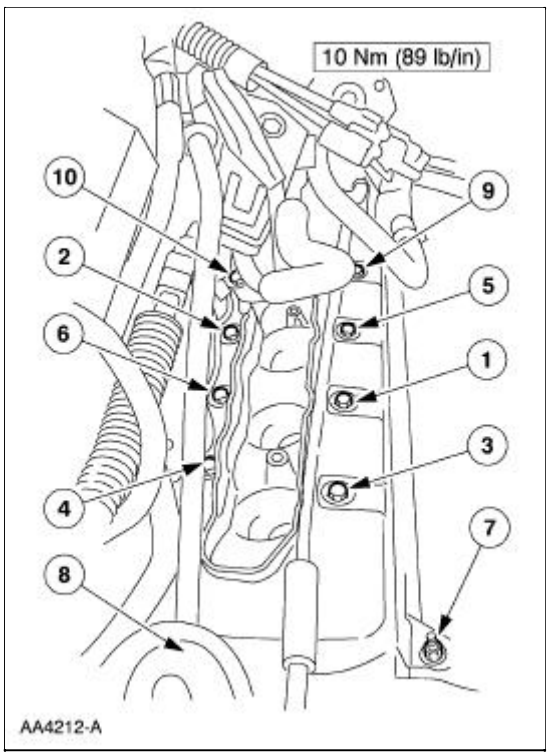
38. Remove the belt idler pulleys.



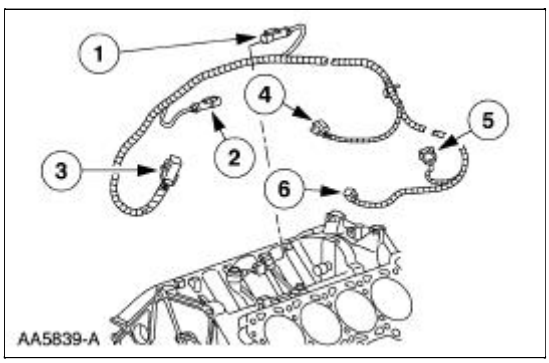
39. Remove the bolts and the LH valve cover.



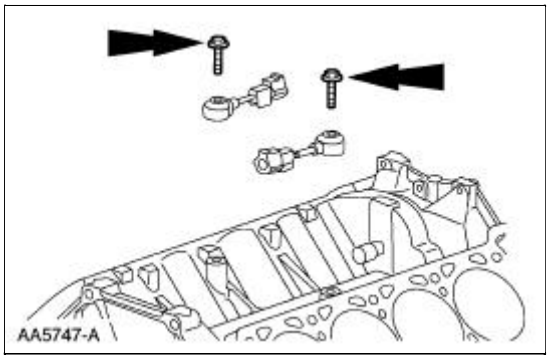
40. Remove the bolts and the RH valve cover.



41. Remove the knock sensor wiring harness.
    1. LH knock sensor electrical connector.
    2. RH knock sensor electrical connector.
    3. Engine control sensor electrical connector.
    4. Fuel injector electrical connector.
    5. A/C compressor electrical connector.
    6. Crankshaft position sensor (CKP) electrical connector.

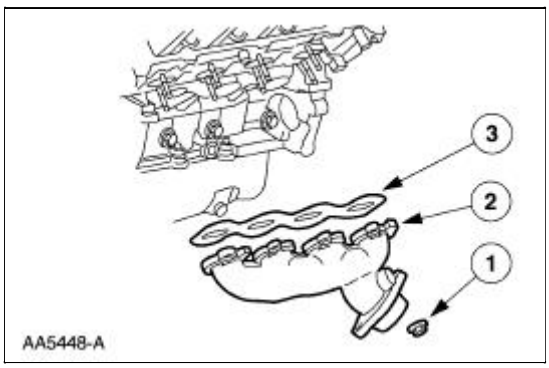


42. Remove the knock sensors.

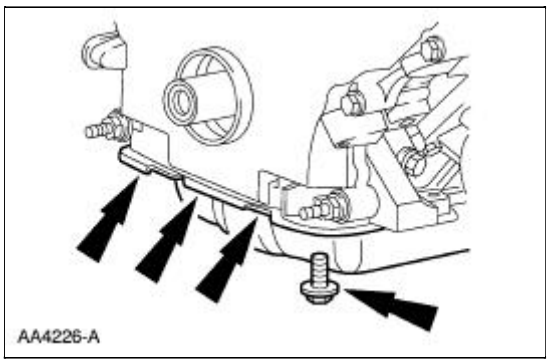


43. **NOTE:** LH side is shown; RH side is similar.

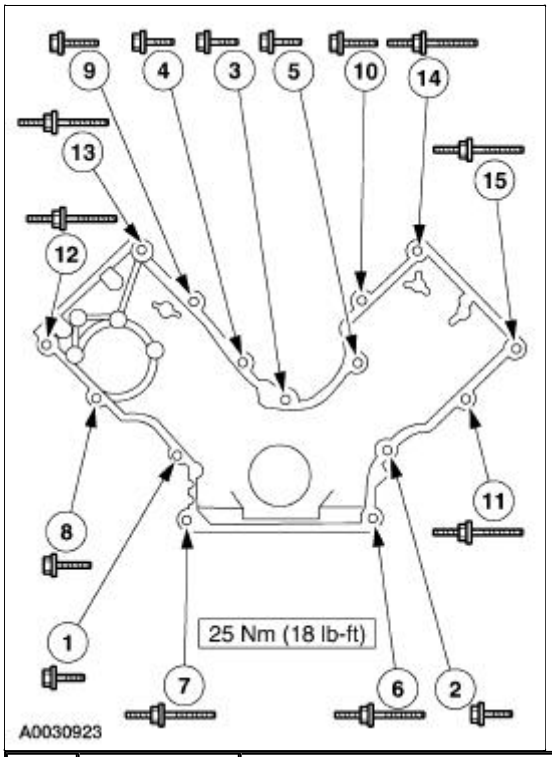
    Remove the exhaust manifolds.
    1. Remove the nuts.
    2. Remove the LH and RH exhaust manifolds.
    3. Remove the exhaust manifold gaskets.



44. Remove the four bolts.



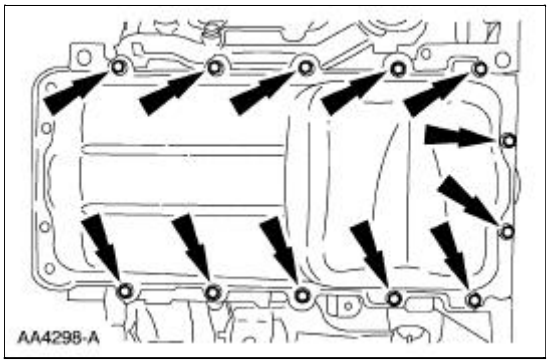
45. Remove the engine front cover.



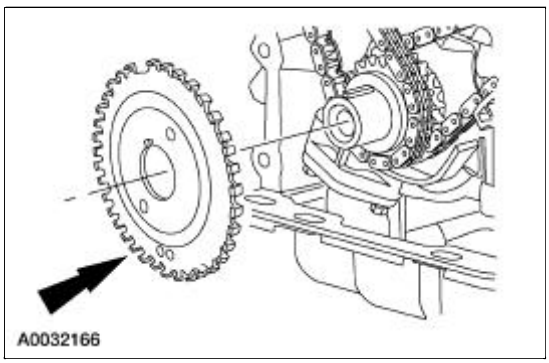
Item	Part Number	Description
1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	W706508	Stud, Hex Shldr Pilot, M8 x 1.25 x 50 — M6 x 1 x 10
7	N808586	Stud and Washer, Hex-Head Pilot, M8 x 1.25 x 60 — M6 x 1 x 26
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
12	W706560	Stud, Hex-Head Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 16
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26

46. **NOTE:** Be careful when removing the gasket. It is reusable if not damaged.

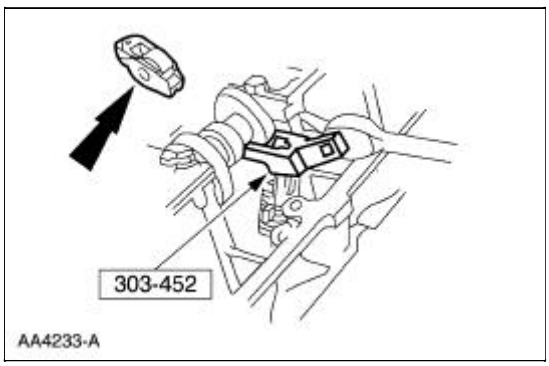
    Remove the oil pan and the gasket.



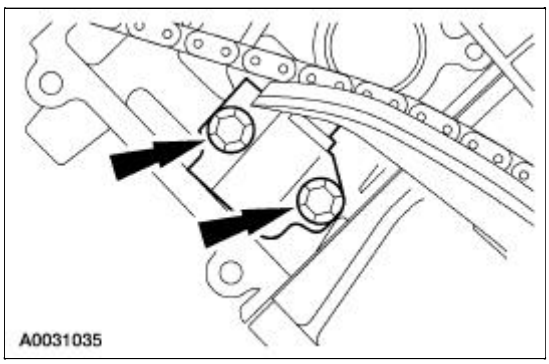
47. Remove the CKP sensor pulse wheel.



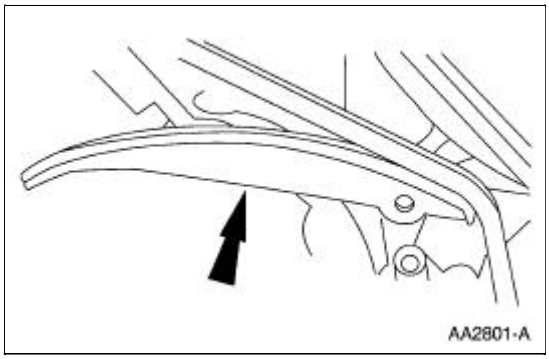
48. Using the special tool, remove the 32 roller followers.



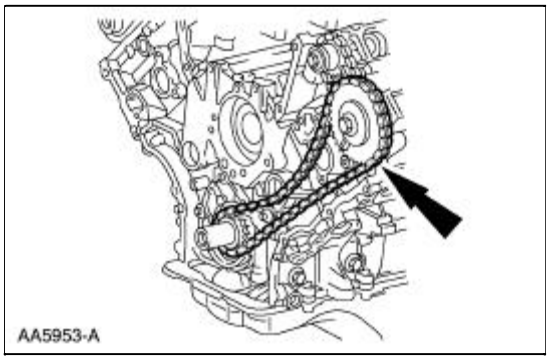
49. Remove the bolts and the RH and LH timing chain tensioners.



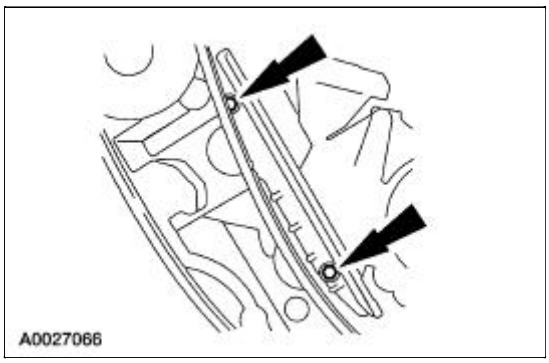
50. Remove the RH and LH timing chain tensioner arms.



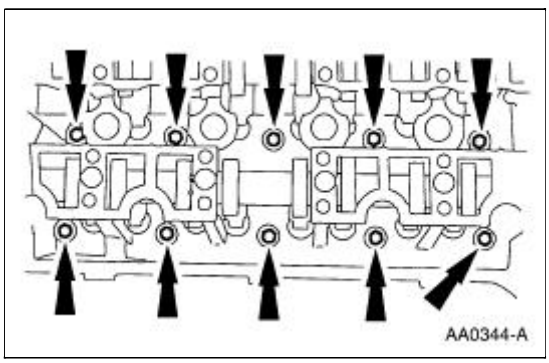
51. Remove the RH and the LH timing chains and crankshaft sprocket.



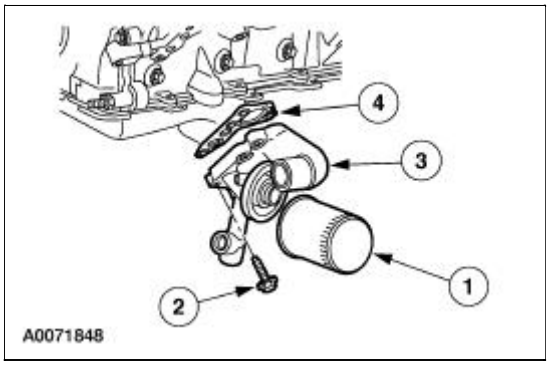
52. Remove the RH and LH timing chain guides.



53. Remove the RH and LH cylinder heads.

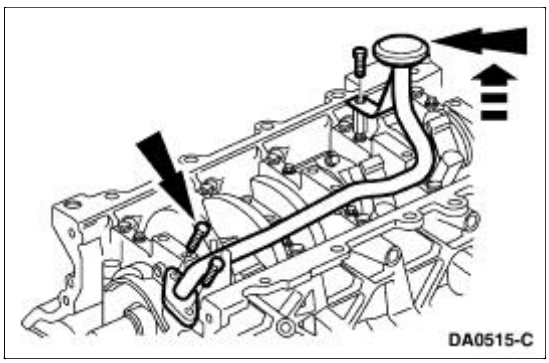


54. Remove the oil filter adapter.
    1. Remove the oil filter.
    2. Remove the bolts.
    3. Remove the oil filter adapter.
    4. Remove the gasket.

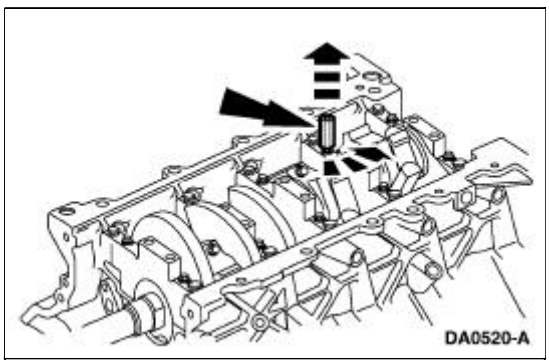


55. Clean and inspect the oil filter adapter.
    - Flush the adapter with parts cleaner. If metal particles are present, install a new oil filter adapter.

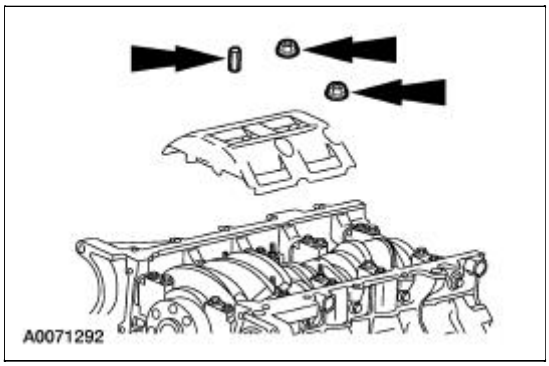
56. Remove the bolts and the oil pump screen and pickup tube.



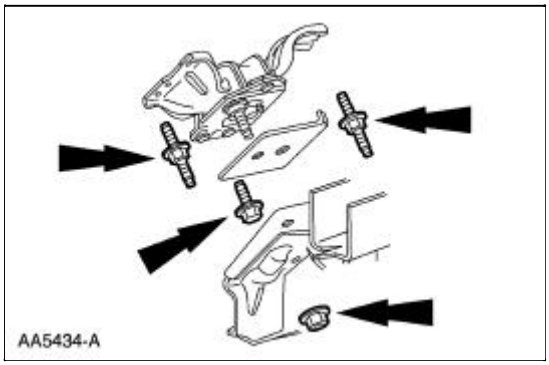
57. Remove the oil pump screen and pickup tube spacer.



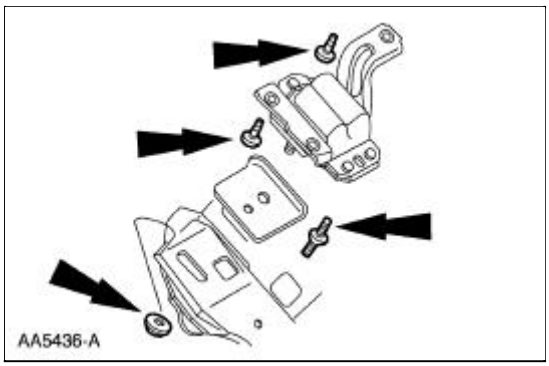
58. Remove the nuts and the windage tray.



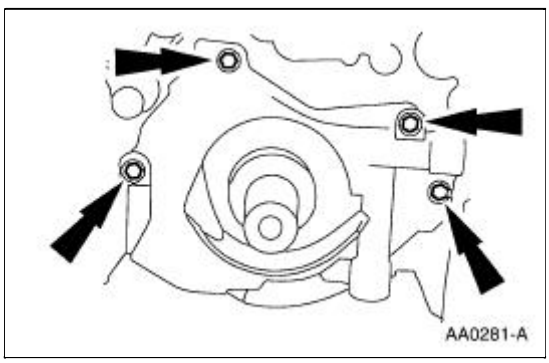
59. Remove the LH engine mount.



60. Remove the RH engine mount.



61. Remove the bolts and the oil pump.

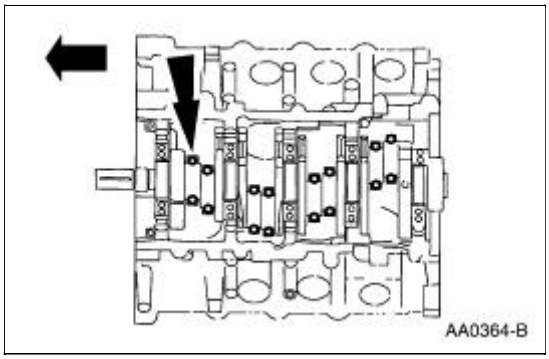


62. **CAUTION: Do not stamp the top of pistons, as ring land damage can occur.**

NOTE: Connecting rods and rod caps should be numbered to keep the correct orientation in the following sequence.

Remove the connecting rod caps for piston number 1 and 6.

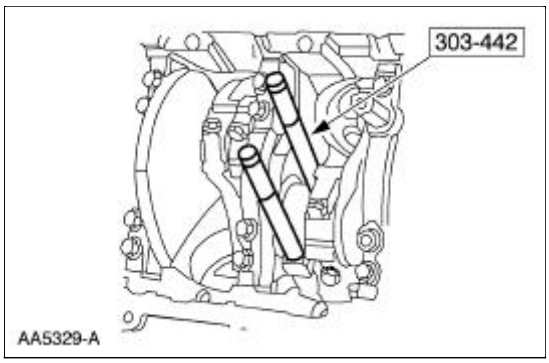
- Discard the bolts.



63. **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

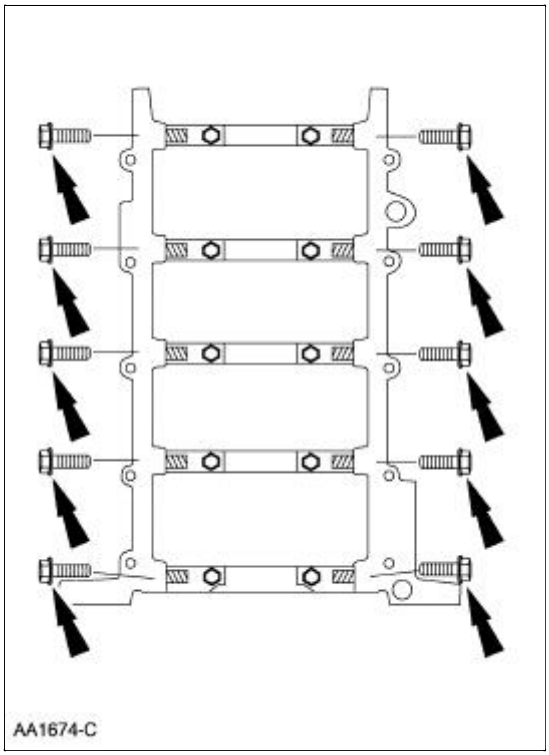
    NOTE: Before removing pistons, inspect the top of the cylinder bores. If necessary, remove the ridge or carbon deposits from each cylinder using a cylinder ridge reamer following manufacturer's instructions.

    Using the special tool, push pistons number 1 and 6 through the top of the cylinder block.

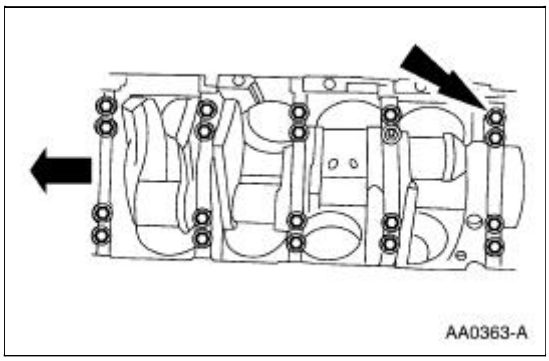


64. To remove pistons 3 and 5, 4 and 7, 2 and 8, turn crankshaft 90 degrees and repeat the previous two steps.

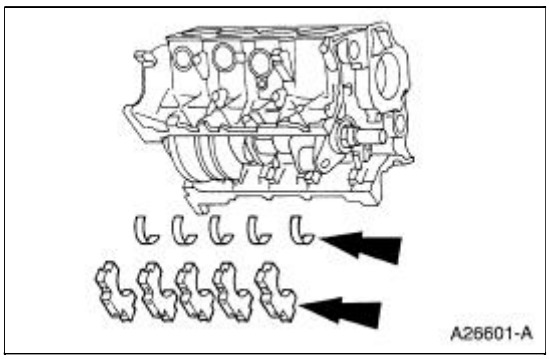
65. Remove the side main bearing cap bolts.



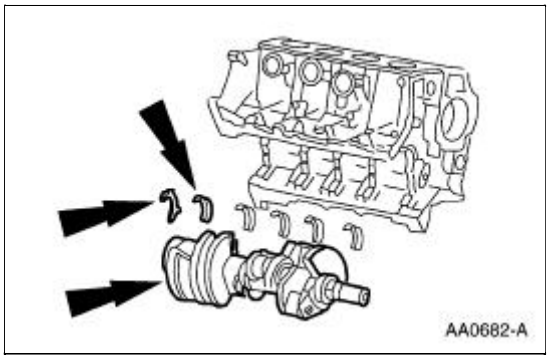
66. Remove and discard the main bearing cap bolts.



67. Remove the main bearing caps and the crankshaft lower main bearings from the cylinder block.

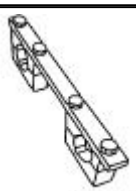
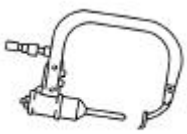


68. Remove the crankshaft, the crankshaft thrust washer, and the crankshaft upper main bearings from the cylinder block.


AA0682-A

Cylinder Head

Special Tool(s)

ST2373-A	Compressor, Valve Spring (Exhaust Side) 303-567 (T97P-6565-AH)
ST1718-A	Compressor, Valve Spring (Intake Side) 303-452 (T93P-6565-AR)
 ST1715-A	Holding Tool, Camshaft 303-446 (T93P-6256-AHR)
 ST1716-A	Compressor, Valve Spring, Air Operated 134-R0207 or equivalent
ST1332-A	Installer, Valve Stem Oil Seal 303-383 (T91P-6571-A)

Material

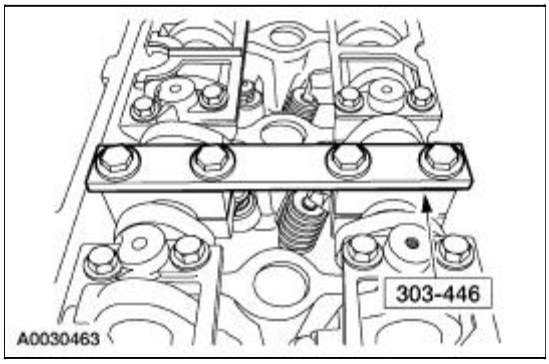
Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H

Disassembly

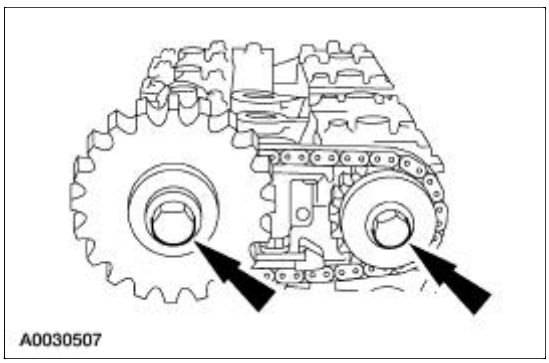
1. **CAUTION: Do not place the cylinder head flat on the bench; the valves will bend.**

   CAUTION: Before disassembly begins, mark the valve position on the face of each valve being removed. The valves must be re-installed into the same positions.

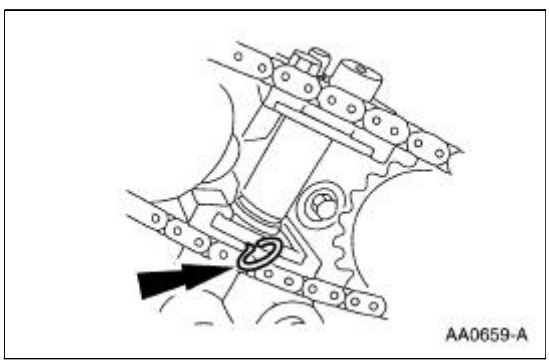
Install the special tool.



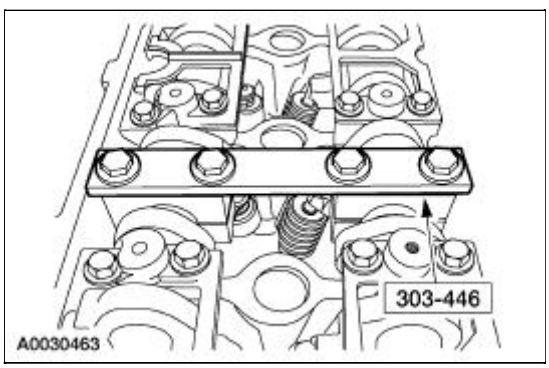
2. Remove the exhaust camshaft sprocket and the intake camshaft bolt, washer and spacer.



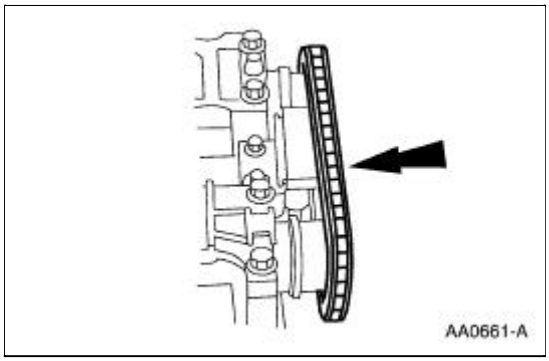
3. Compress the tensioner and install a lock pin.



4. Remove the special tool.

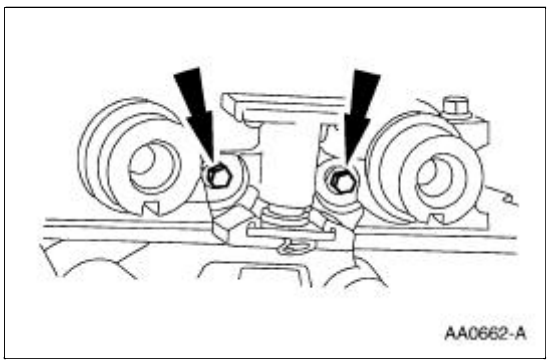


5. Remove the timing chain and the camshaft sprocket.

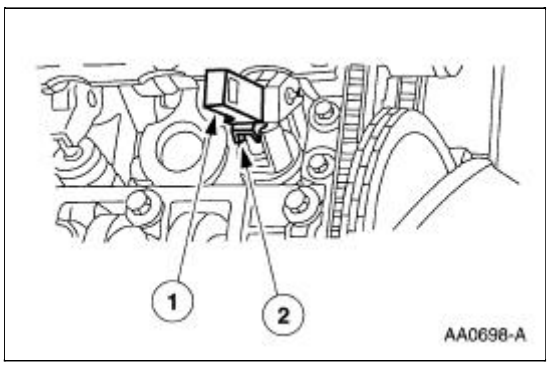


6. **NOTE:** LH tensioner is shown, RH tensioner is similar.

   Remove the tensioner.

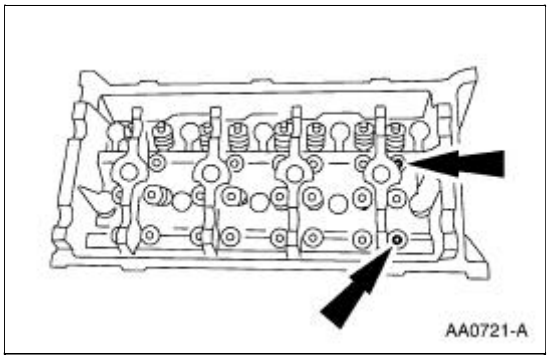


7. Remove the roller followers on the base circle.
   1. Install the special tool on the valve spring.
   2. Compress the tool and remove the roller follower.



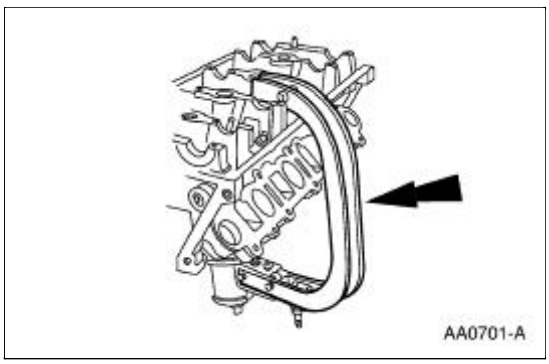
8. Repeat the previous step for the remaining roller followers.

9. Remove the hydraulic lash adjusters.

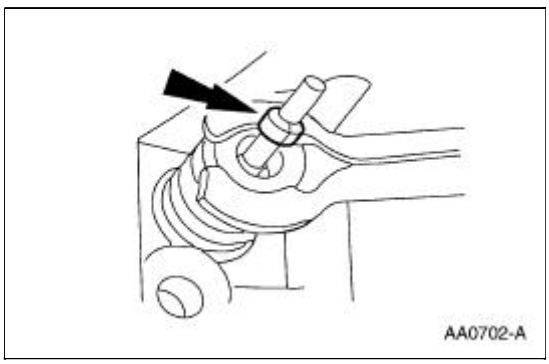


10. **CAUTION: Make sure the tool is seated correctly on the valve spring. Apply a small amount of air at a time. This will prevent the tool from shifting and causing damage to the cylinder head.**

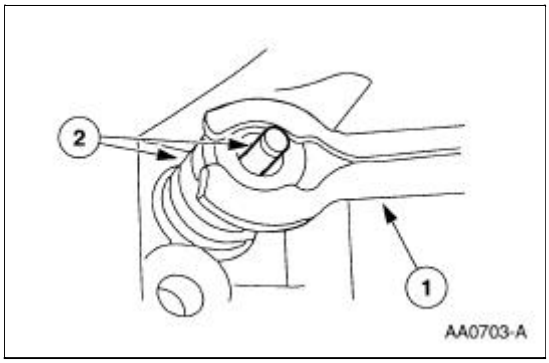
    Install the air-operated spring compressor on the cylinder head.



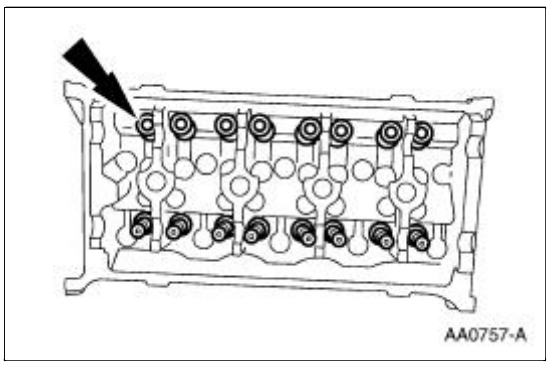
11. Compress the valve spring compressor and remove the key from the valves.



12. Remove the intake valves and the valve springs.
    1. Release the pressure and remove the valve spring compressor.
    2. Remove the intake valves and the valve springs from the cylinder head.



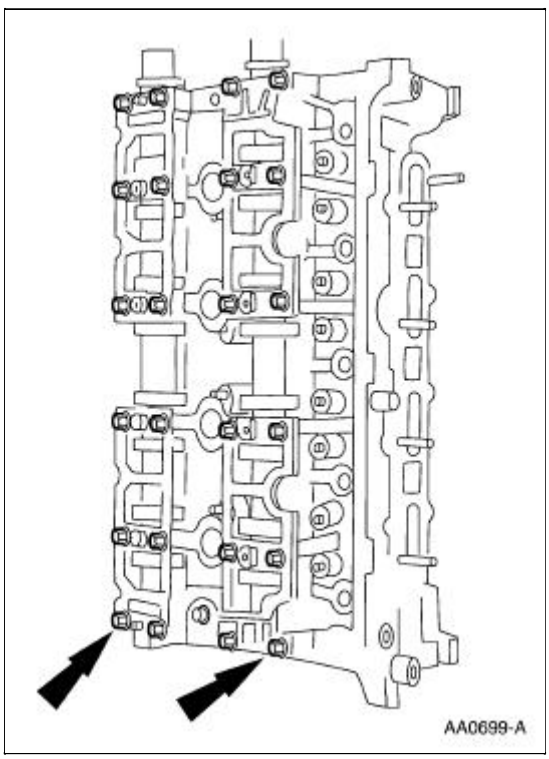
13. Remove the valve stem seals.



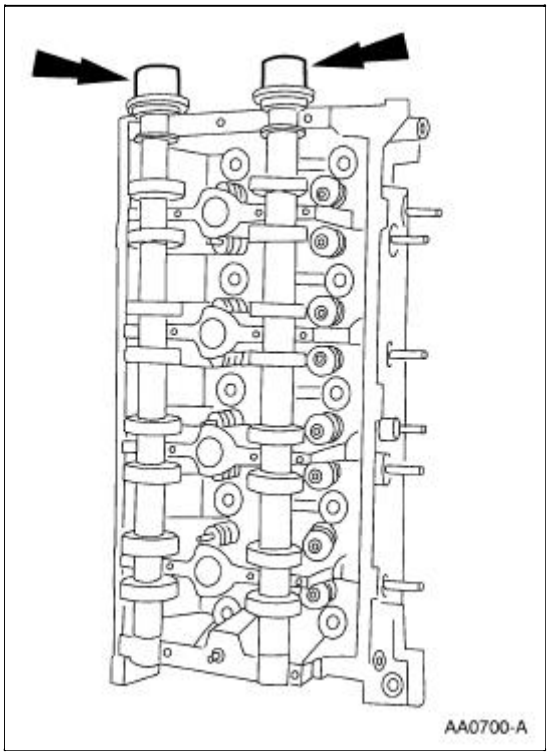
14. **CAUTION: The outer bolts on the outer cam bearing cap (exhaust) are longer and must be returned to the same location or engine damage may occur.**

NOTE: Identify the camshaft-to-cylinder head location. Caps are not interchangeable.

Remove the bolts and the camshaft bearing cap assemblies.

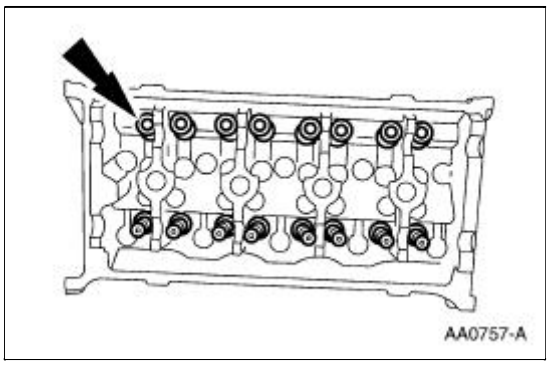


15. Remove the camshafts.



Assembly

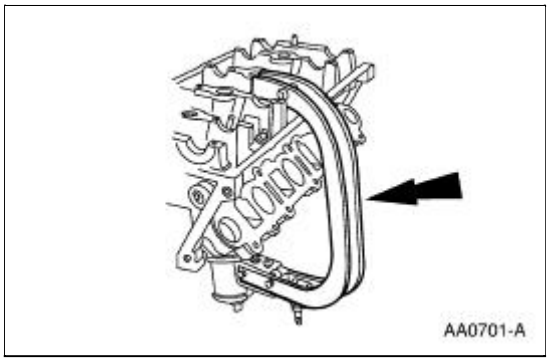
1. Install the valve stem seals.



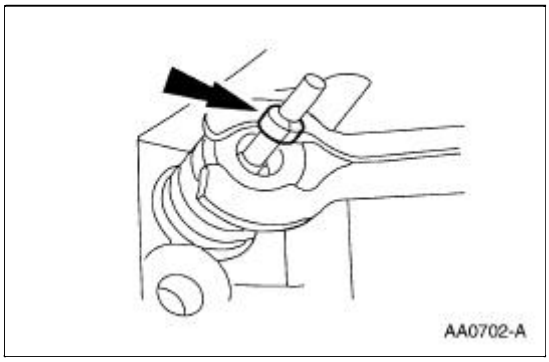
2. Install the valves and the valve springs.

3. **CAUTION: Make sure the tool is seated correctly on the valve spring. Apply a small amount of air at a time. This will prevent the tool from shifting and causing damage to the cylinder head.**

   Install the air-operated spring compressor on the cylinder head.



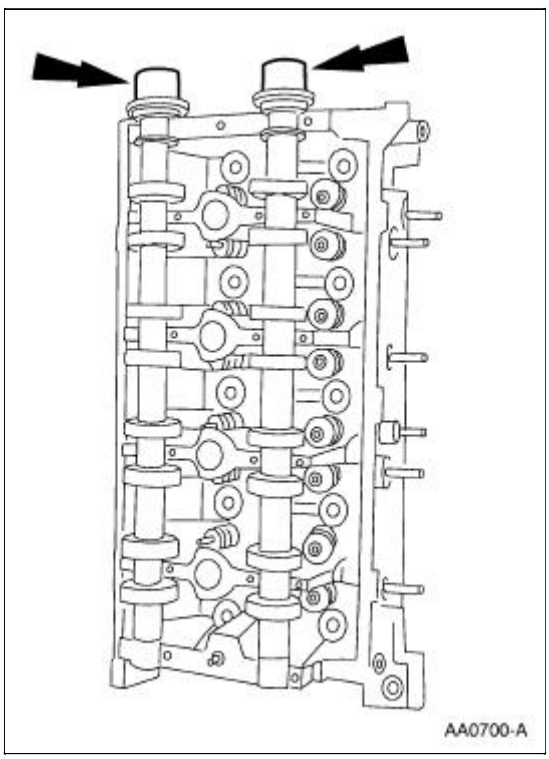
4. Compress the valve spring compressor and install the key on the valves.



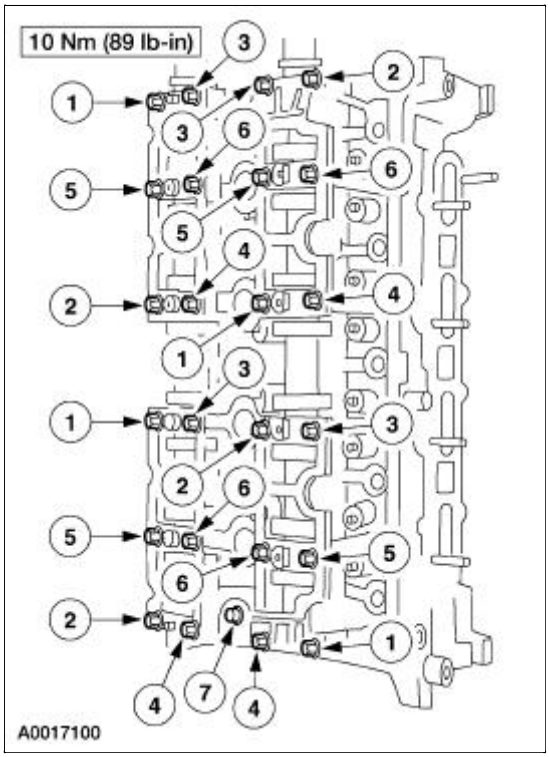
5. **NOTE:** LH is shown, RH is similar.

   Install the camshafts.

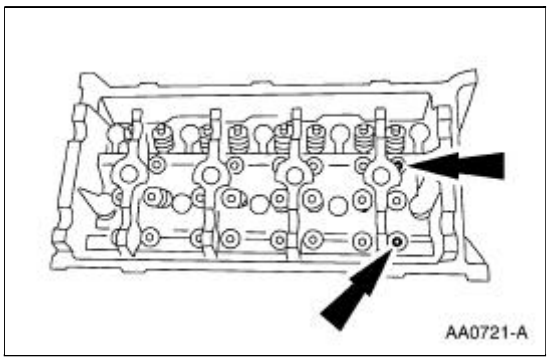
   - Lubricate the camshafts with clean engine oil.



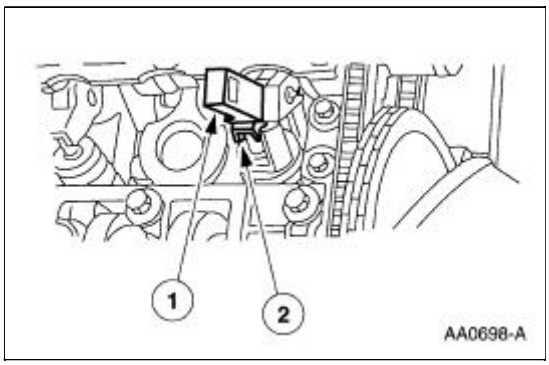
6. Install the camshaft bearing cap assemblies.



7. Install the hydraulic lash adjusters.



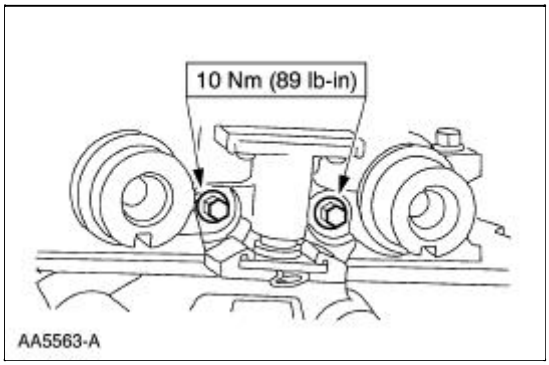
8. Install the roller followers.
    1. Install the special tool on the valve spring.
    2. Compress the spring and install the roller follower.



9. Repeat the previous step for the remaining roller followers.

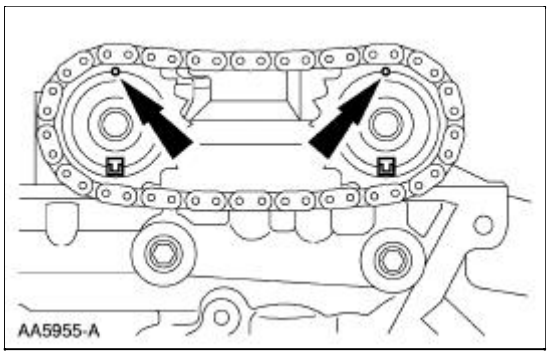
10. **NOTE:** LH tensioner is shown, RH tensioner is similar.

Install the tensioner.

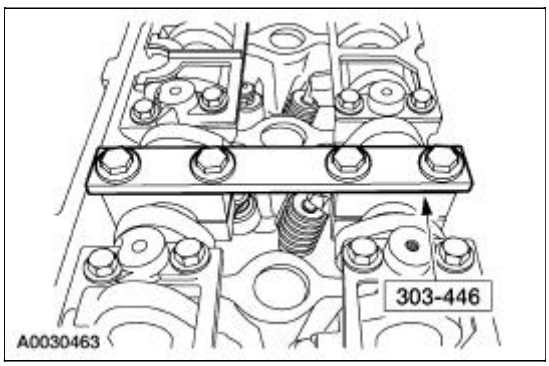


11. **CAUTION: Timing marks must be at 12 o'clock and indexed at 6 o'clock.**

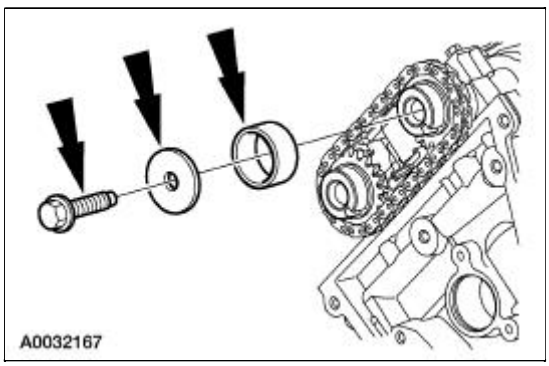
    Install the camshaft sprockets and the chain as an assembly.



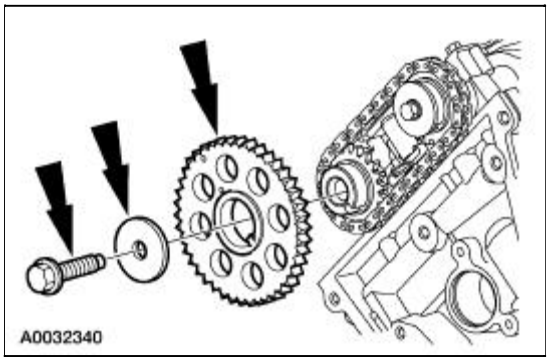
12. Install the special tool.



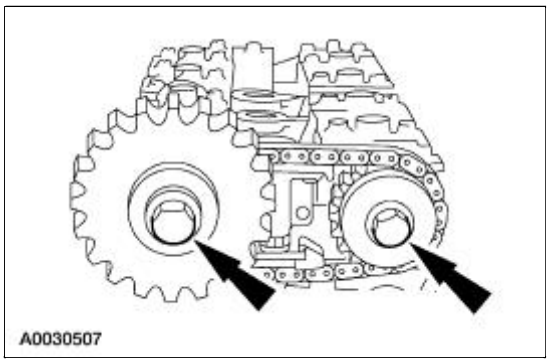
13. Install the camshaft spacer, washer and bolt, and hand-tighten the bolt.



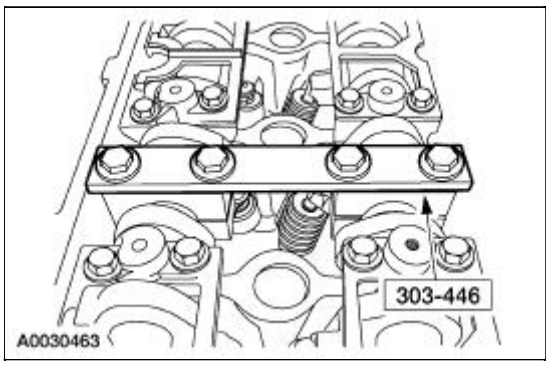
14. Install the camshaft sprocket, washer and bolt, and hand-tighten the bolt.



15. Tighten the bolts in two stages:
    - Stage 1: Tighten to 40 Nm (30 lb-ft).
    - Stage 2: Tighten and additional 90 degrees.



16. Remove the special tool.



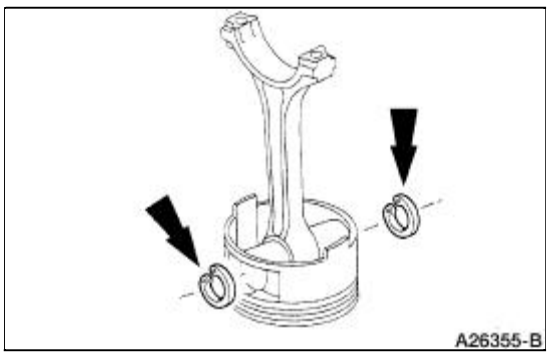
Piston —Pin Connecting Rod, Floating Pin

Material

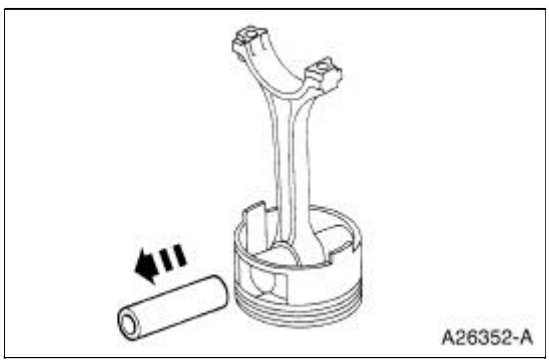
Item	Specification
SAE 5W-20 Premium Synthetic Blend Engine Oil XO-5W20-QSP	WSS-M2C153-H

Disassembly

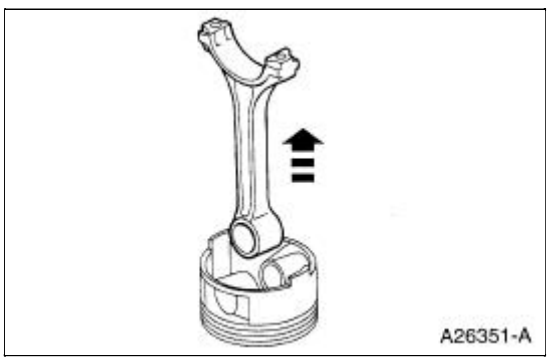
1. Remove the clips.



2. Remove the piston pin from the piston and connecting rod assembly.



3. Remove the connecting rod from the piston.

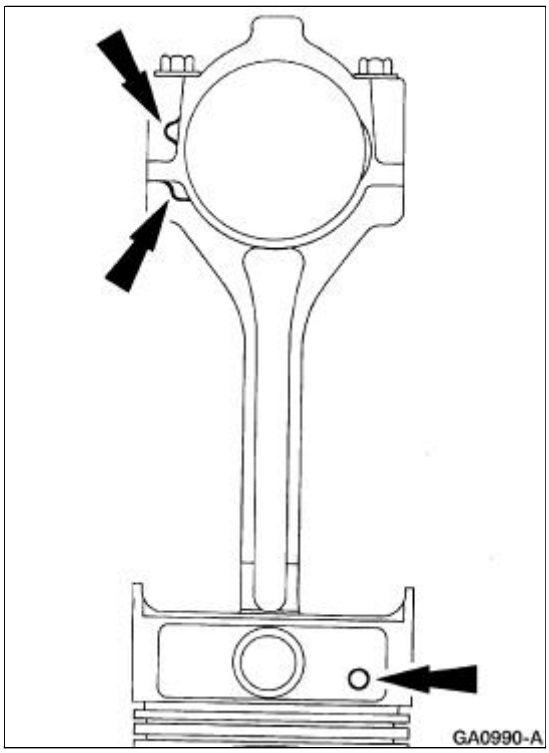


4. Clean and inspect the piston and connecting rod. For additional information, refer to Section 303-00 .

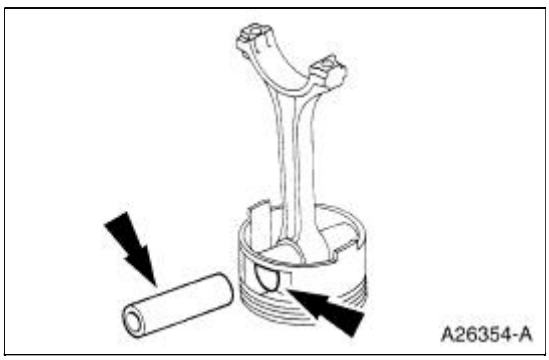
Assembly

1. **NOTE:** Connecting rod must be installed into piston with identification markings toward front.

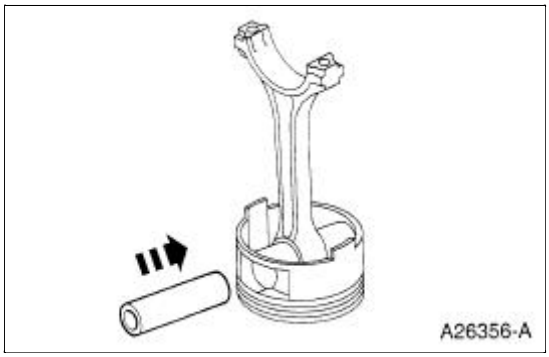
   Position the connecting rod in the piston.



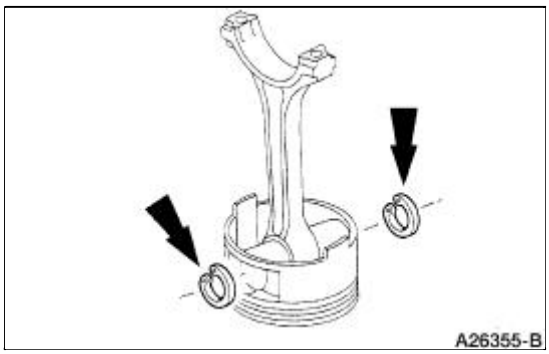
2. Lubricate the piston pin and pin bore with clean engine oil.



3. Install the piston pin in the piston and connecting rod assembly.

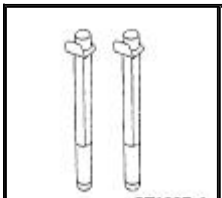
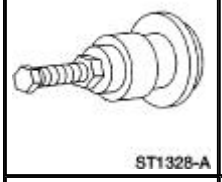
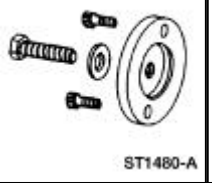


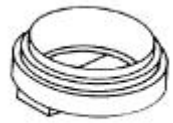
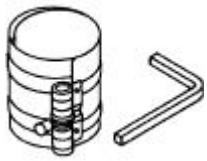
4. Install the piston pin retaining clips in the piston.



Engine

Special Tool(s)

 ST1337-A	Guides, Connecting Rod 303-442 (T93P-6136-A)
ST1287-A	Installer, Crankshaft Vibration Damper 303-102 (T74P-6316-B)
 ST1328-A	Installer, Front Cover Oil Seal 303-335 (T88T-6701-A)
 ST1480-A	Installer, Crankshaft Rear Oil Seal 303-518 (T95P-6701-DH)
ST1482-A	Installer, Crankshaft Rear Oil Slinger 303-517 (T95P-6701-CH)
ST1718-A	Compressor, Valve Spring (Intake) 303-452 (T93P-6565-AR)
ST1693-A	Compressor, Valve Spring (Exhaust) 303-567 (T97P-6565-AH)
	Installer, Crankshaft Rear Oil Seal

 ST1479-A	303-516 (T95P-6701-BH)
	Compressor, Piston Ring 303-D032 (D81L-6002-C) or equivalent
ST1335-A	Holding Tool, Crankshaft 303-448 (T93P-6303-A)

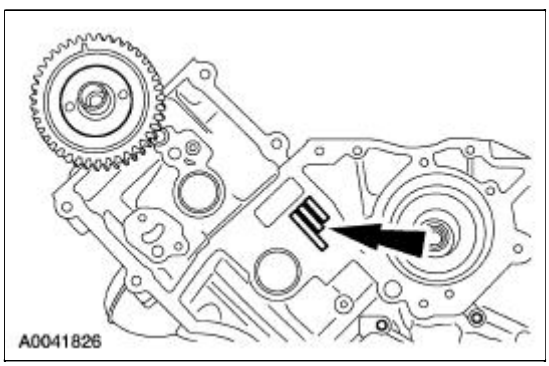
Material

Item	Specification
Metal Surface Cleaner F4AZ-19A536-RA or equivalent	WSE-M5B392-A
Silicone Gasket and Sealant F7AZ-19554-EA or equivalent	WSE-M4G323-A4
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1

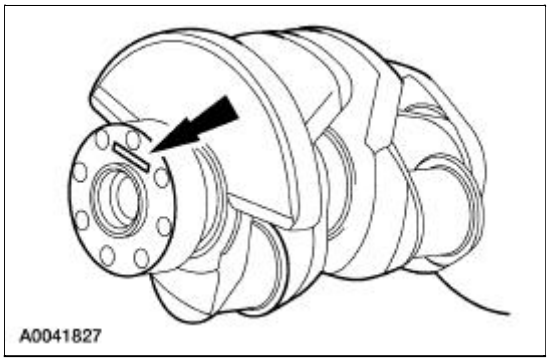
Assembly

All vehicles

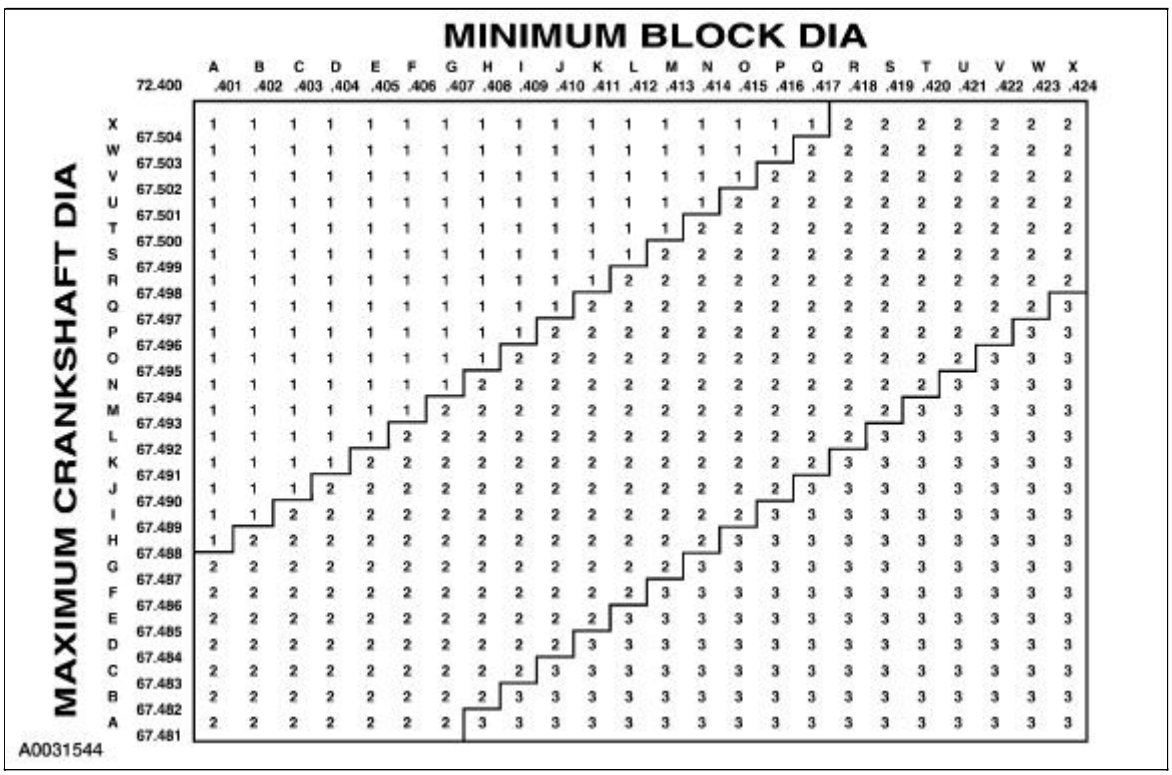
1. Record the main bearing code found on the front of the engine block.



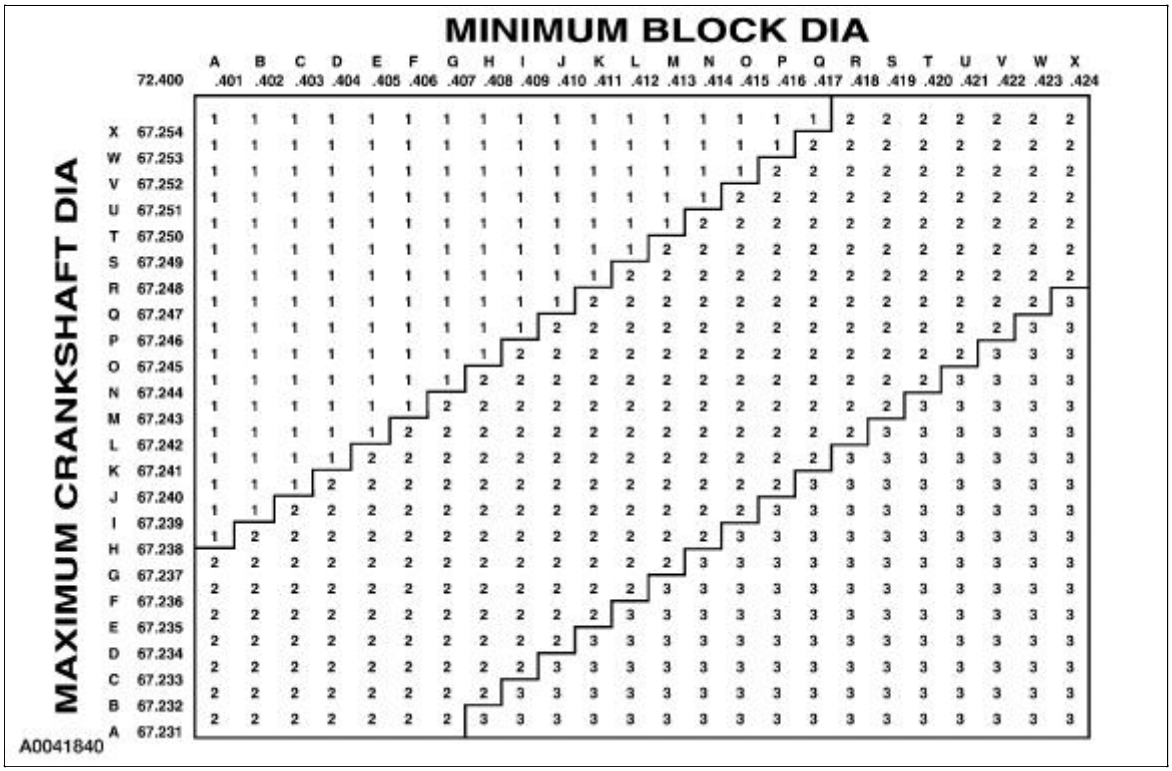
2. Record the main bearing code found on the back of the crankshaft.



3. Using the data recorded earlier and the Bearing Select Fit Chart, Standard Bearings Chart determine the required bearing grade for each main bearing.
    - Read the first letter of the engine block main bearing code and the first letter of the crankshaft main bearing code.
    - Read down the column below the engine block main bearing code letter, and across the row next to the crankshaft main bearing code letter, until the two intersect. This is the required bearing grade for the number one crankshaft main bearing.
    - As an example, if the engine block code letter is "F" and the crankshaft code letter is "D," the correct bearing grade for this main bearing is "2."
    - Repeat this process for the remaining four main bearings.



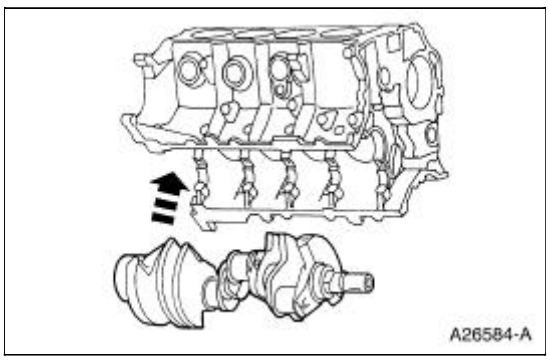
4. If oversize bearings are being used, use the procedure in the previous step and the Bearing Select Fit Chart, Oversize Bearing Chart to determine the required grade for each main bearing.



NOTE: Before assembling the cylinder block, all sealing surfaces must be free from chips, dirt, paint and foreign material. Also, make sure the coolant and oil passages are clear.

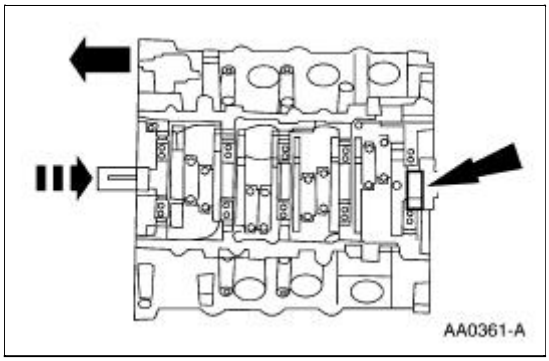
5. Install the upper main bearings into the cylinder block and the lower main bearing into the crankshaft main bearing caps. Lubricate the main bearings with clean engine oil.

6. Install the crankshaft into the cylinder block.

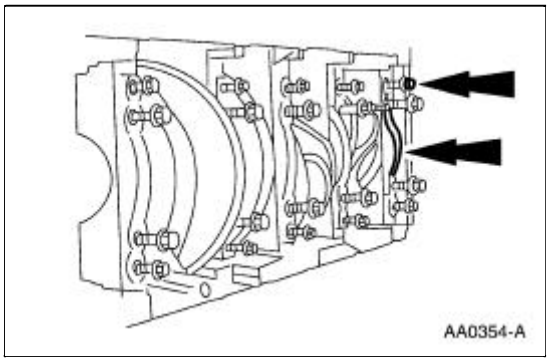


7. **CAUTION: Make sure the coated side of the thrust washer with the 5-mm wide oil grooves faces the crankshaft thrust surface.**

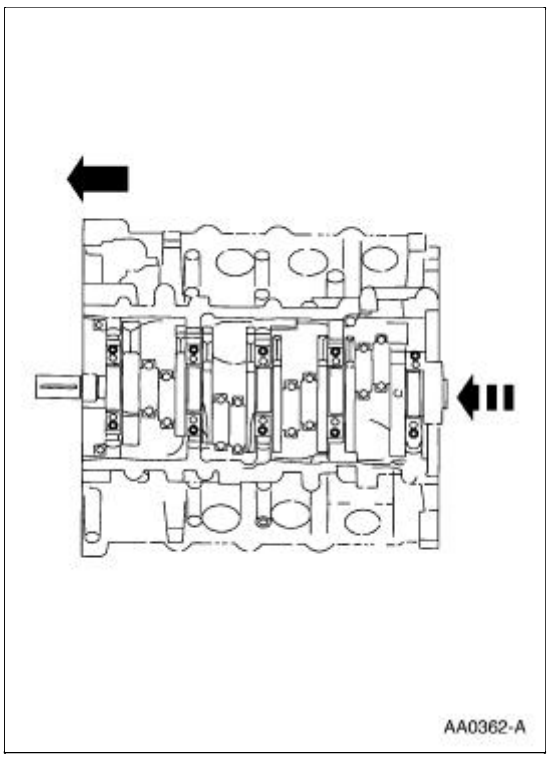
   Push the crankshaft rearward and install the crankshaft thrust washer at the back of the No. 5 main boss.



8. Loosely install the main bearing caps and the bolts.

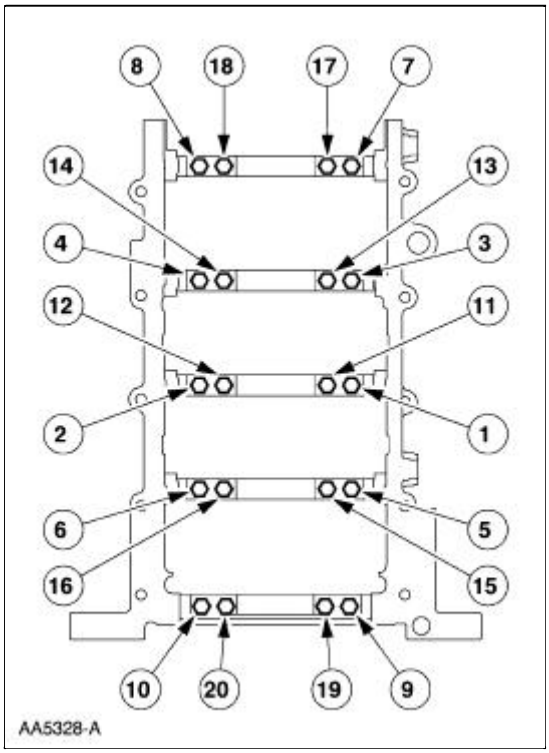


9. Push the crankshaft forward to seat the crankshaft thrust washer and hold the crankshaft in the forward position.

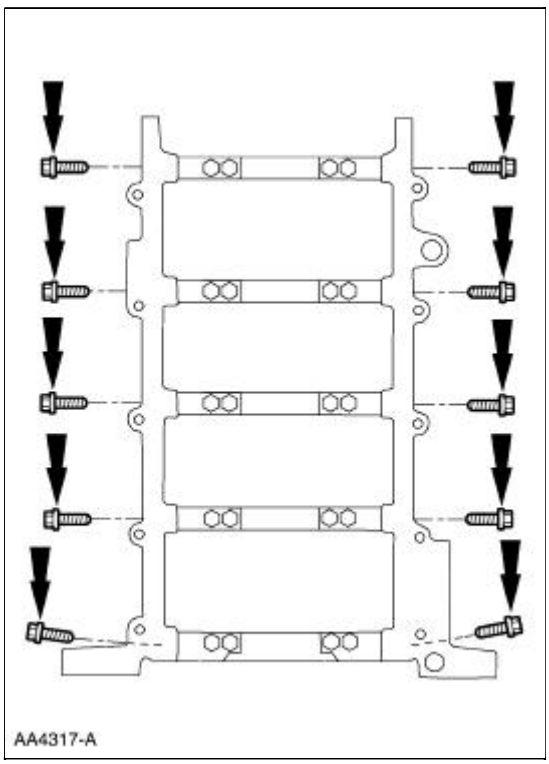


10. Tighten bolts 1-20 in sequence shown in four stages.
    - Stage 1: tighten to 10 Nm (89 lb-in).
    - Stage 2: tighten to 25 Nm (18 lb-ft).
    - Stage 3: tighten to 40 Nm (30 lb-ft).

- Stage 4: tighten an additional 90 degrees.



11. Install and tighten the cross-mounted bolts in two stages.
    - Stage 1: tighten to 40 Nm (30 lb-ft).
    - Stage 2: tighten an additional 90 degrees.



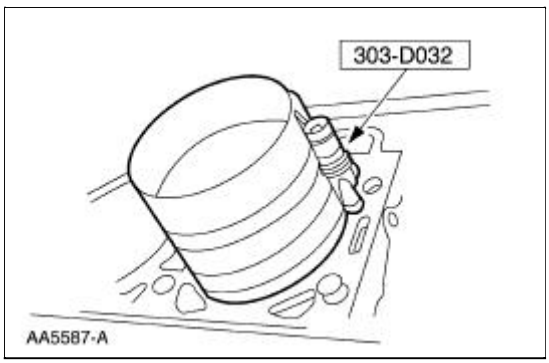
12. Check the crankshaft end play. For additional information, refer to Section 303-00 .

13. **CAUTION: Do not scratch the cylinder walls or crankshaft journals with the connecting rod.**

    NOTE: Make sure that the piston arrow is facing forward.

    NOTE: Lubricate the piston rings, cylinder walls and connecting rod bearings with clean engine oil.

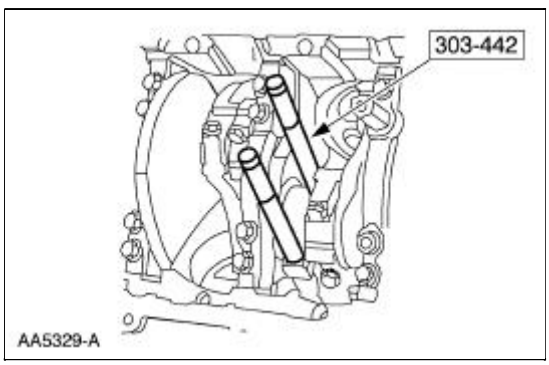
    Using the special tool push the pistons through the top of the cylinder block.



14. **CAUTION: Do not scratch the cylinder walls or the crankshaft journals with the connecting rod.**

    NOTE: Make sure the crankshaft is at T.D.C.

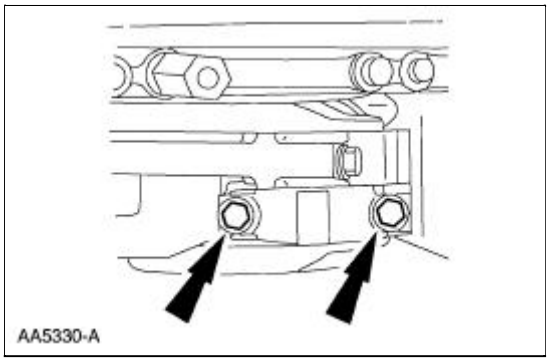
    Using the special tool, install the connecting rod assemblies.



15. **NOTE:** The rod bearing cap bolts are torque-to-yield. Install new bolts each time they are serviced.

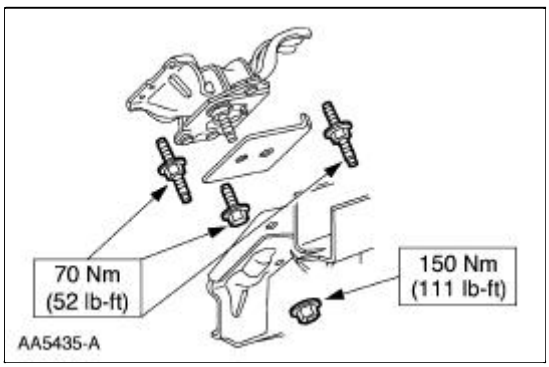
    Install the connecting rod bearing caps and bolts and tighten in three stages.

    - Stage 1: tighten to 25 Nm (18 lb-ft).
    - Stage 2: tighten to 45 Nm (33 lb-ft).
    - Stage 3: tighten an additional 90 degrees.

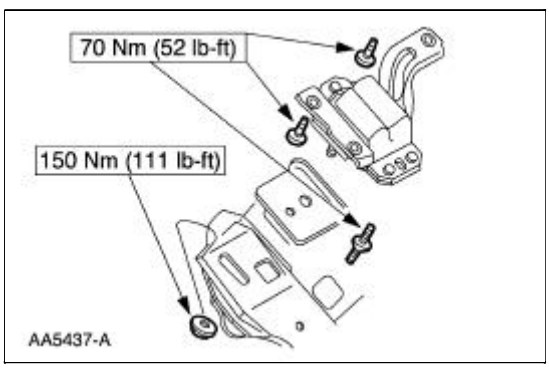


16. Check the connecting rod bearing clearance. For additional information, refer to Section 303-00 .

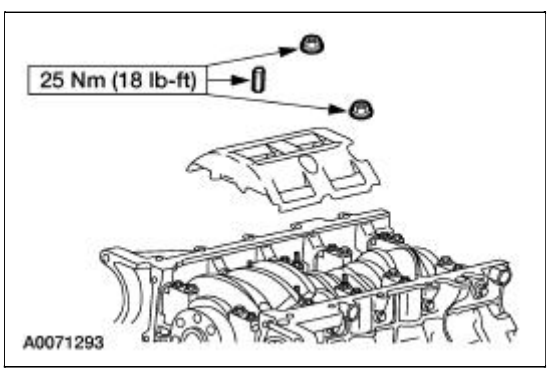
17. Install the LH engine mount.



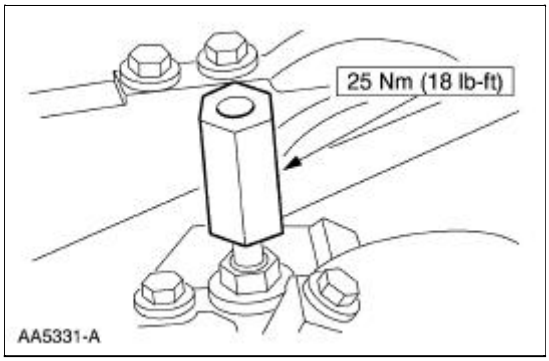
18. Install the RH engine mount.



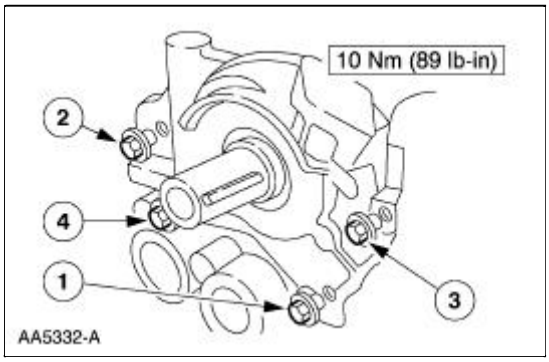
19. Install the nuts and the windage tray.



20. Install and tighten the oil pump screen spacer.

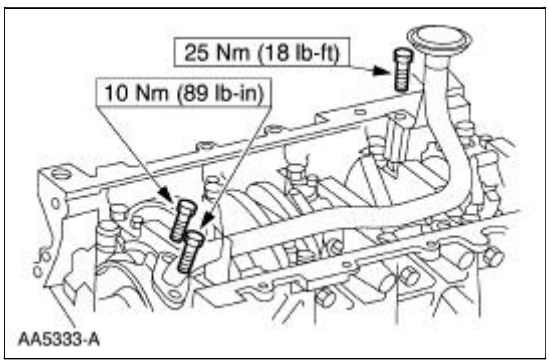


21. Position the oil pump and tighten the bolts in the sequence shown.

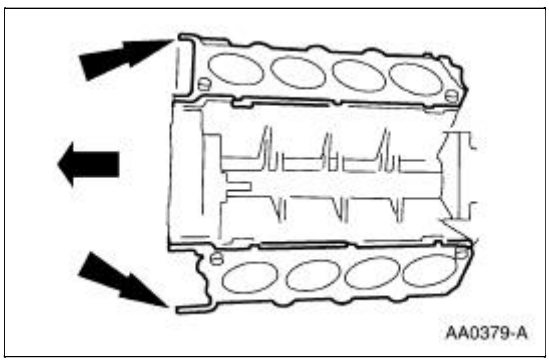


22. **NOTE:** Install a new O-ring if necessary.

    Install the oil pump screen cover and tube.



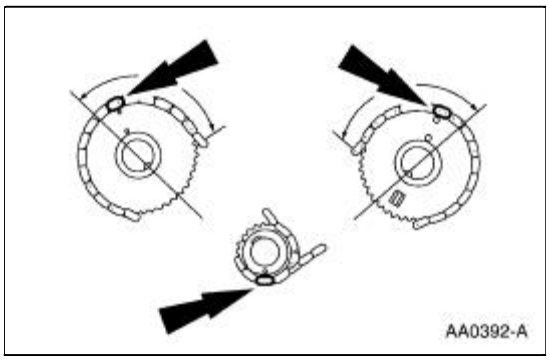
23. Install the cylinder head gaskets.



24. **CAUTION: The camshafts must be positioned so the camshaft keyway is 90 degrees from the valve cover gasket surface to avoid damage to valves and pistons during timing**

procedures.

Make sure the camshaft timing sprockets are positioned correctly.

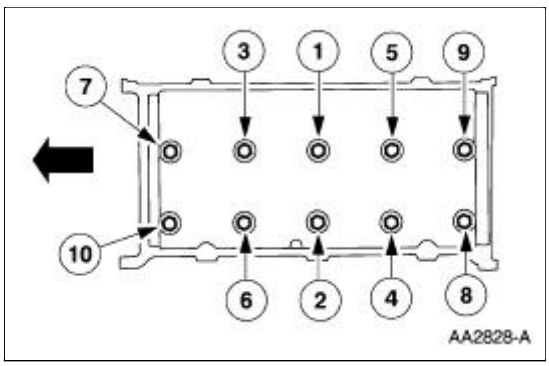


25. **NOTE:** The LH is shown; the RH is similar.

NOTE: Lubricate the bolt heads and threads. Use clean engine oil.

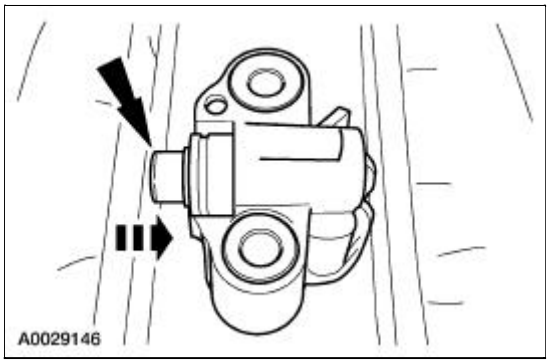
Install the LH and RH cylinder heads and tighten the bolts in six stages in the sequence shown.

- Stage 1: tighten to 40 Nm (30 lb-ft).
- Stage 2: tighten an additional 90 degrees.
- Stage 3: loosen the bolts a minimum of one full turn.
- Stage 4: tighten to 40 Nm (30 lb-ft).
- Stage 5: tighten an additional 90 degrees.
- Stage 6: tighten an additional 90 degrees.

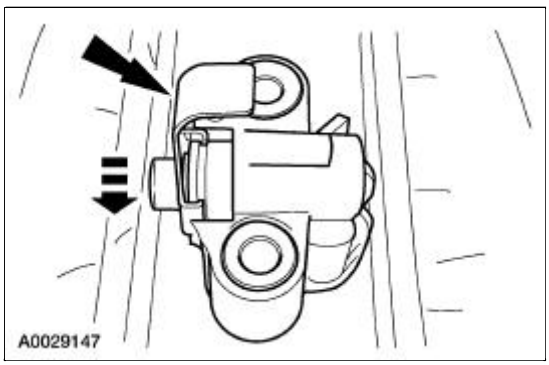


26. **CAUTION: Timing chain procedures must be followed exactly or damage to valves and pistons will result.**

Compress the tensioner plunger, using a vise.

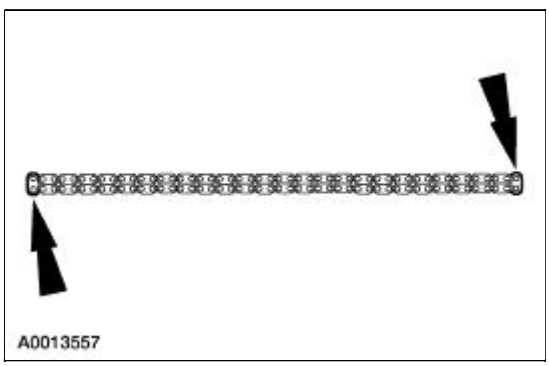


27. Install a retaining clip on the tensioner to hold the plunger in during installation.

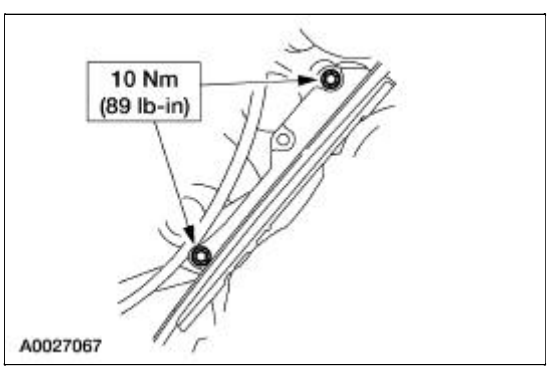


28. Remove the tensioner from the vise.

29. If the copper links are not visible, mark two links on one end and one link on the other end, and use as timing marks.

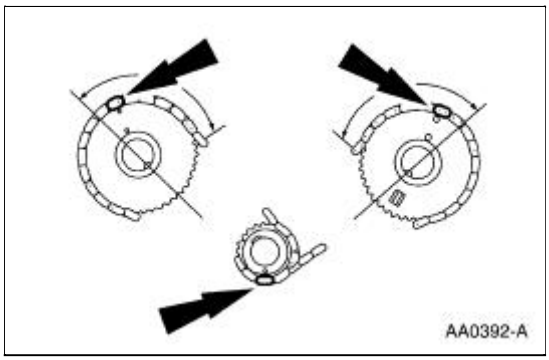


30. Install the timing chain guides.



31. Rotate the LH camshaft timing sprocket until the timing mark is approximately at the 12 o'clock

position. Rotate the RH camshaft timing sprocket until the timing mark is at approximately 11 o'clock position.

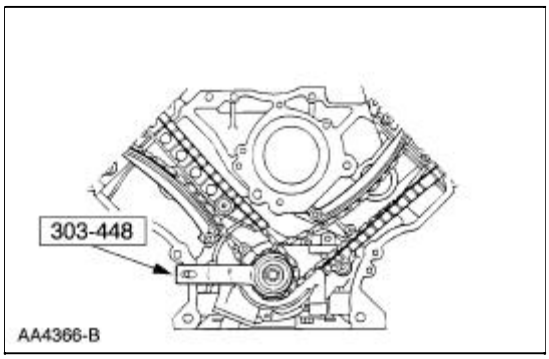


32. **CAUTION: Unless otherwise instructed, at no time when the timing chains are removed and the cylinder heads are installed is the crankshaft or camshaft to be rotated. Severe piston and valve damage will occur.**

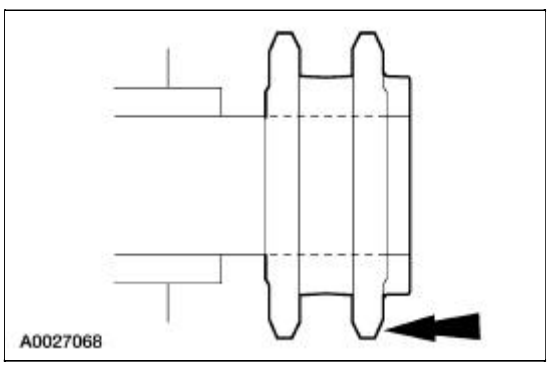
    CAUTION: Rotate the crankshaft counterclockwise only. Do not rotate past position shown or severe piston and/or valve damage will occur.

    Using the special tool, position the crankshaft.

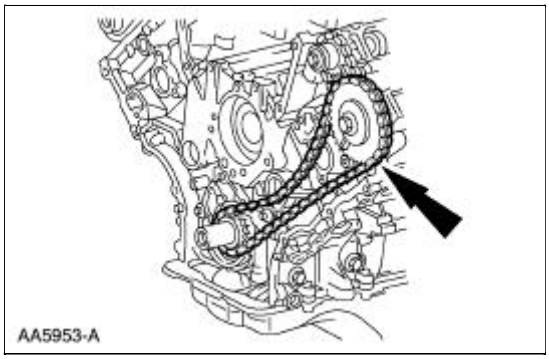
    - Remove the special tool.



33. Install the crankshaft sprocket with the flange facing forward.



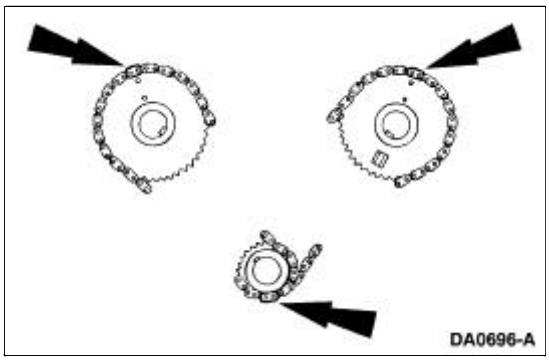
34. Install the LH and RH timing chain onto the crankshaft sprocket, aligning the one copper (or marked) link on the timing chain with the slot on the crankshaft sprocket.



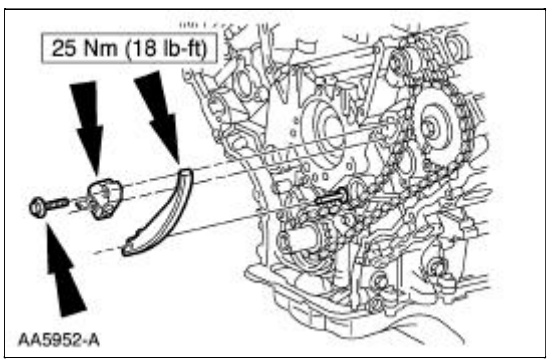
35. **NOTE:** If necessary, adjust the camshaft sprocket slightly to obtain timing mark alignment.

    Position the RH timing chain on the camshaft sprocket. Make sure the two copper-colored links align with the camshaft sprocket timing mark.

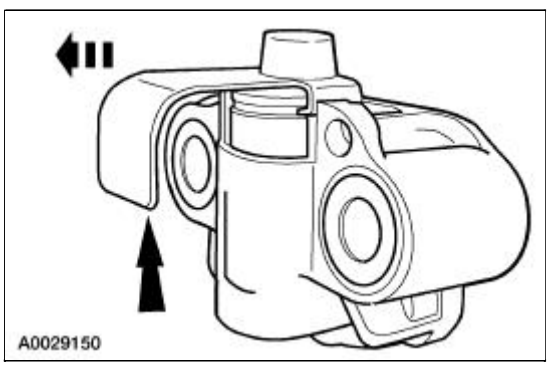
36. As a post-check, verify correct alignment of all timing marks.



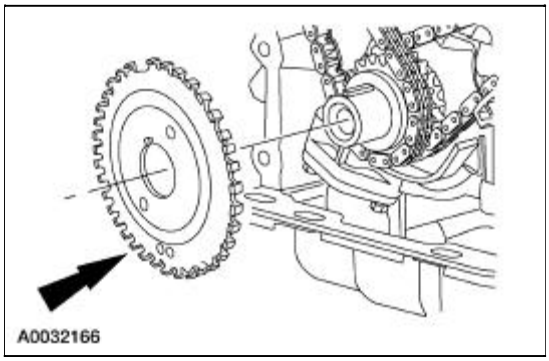
37. Position the LH and RH timing chain tensioner arms on the dowel pins. Position the timing chain tensioner assemblies, and install the bolts.



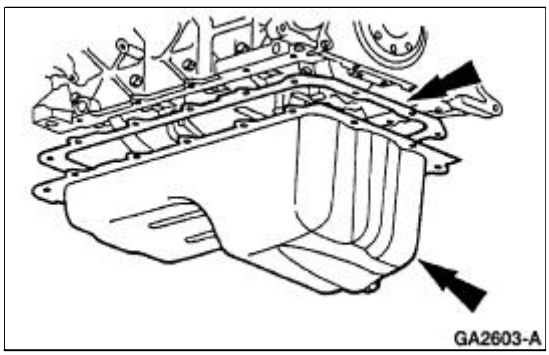
38. Remove the retaining clips from the timing chain tensioners.



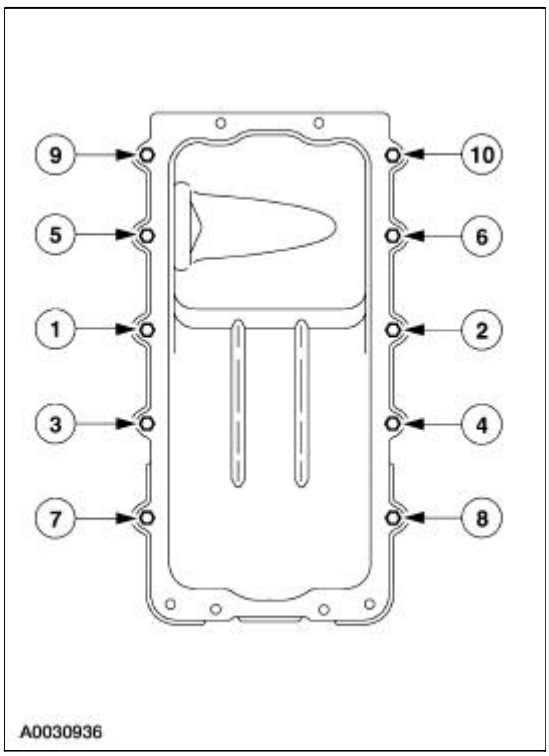
39. Position the crankshaft sensor ring on the crankshaft.



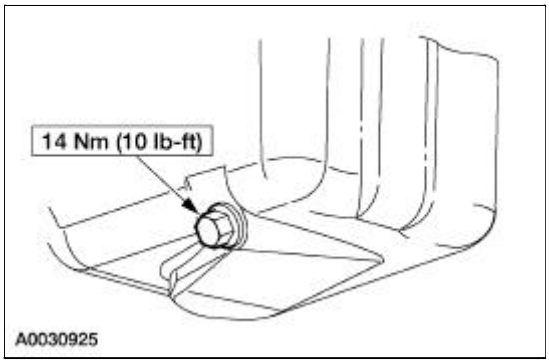
40. Install the oil pan and gasket and loosely install the bolts.



41. Tighten the bolts in the sequence shown.
    - Tighten to 20 Nm (15 lb-ft).
    - Rotate an additional 60 degrees.

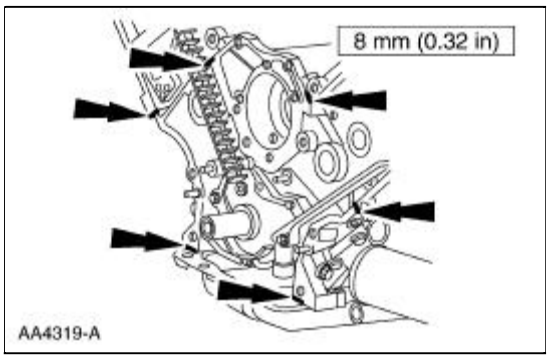


42. Install the drain plugs

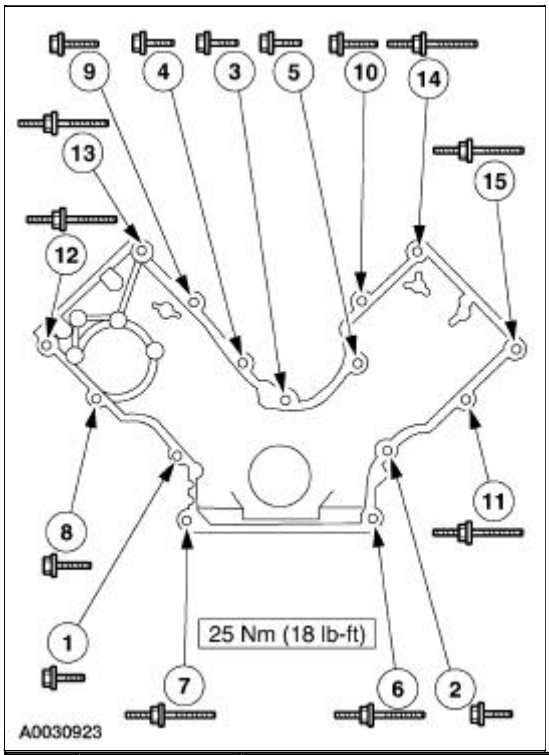


43. **NOTE:** If the engine front cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

    Apply silicone gasket and sealant in the locations shown.



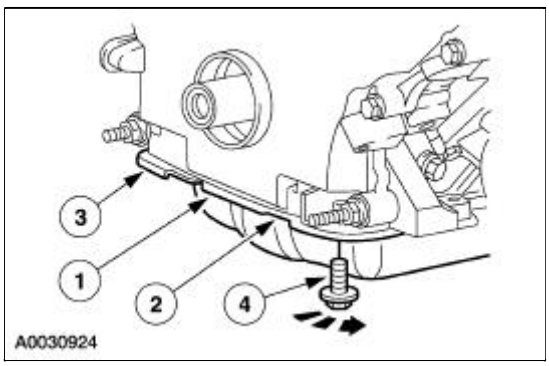
44. Install the engine front cover.



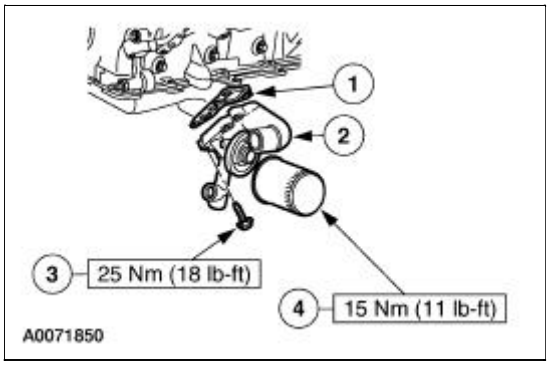
Item	Part Number	Description

1	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
2	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
3	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
4	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
5	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
6	W706508	Stud, Hex Shldr Pilot, M8 x 1.25 x 50 — M6 x 1 x 10
7	N808586	Stud and Washer, Hex-Head Pilot, M8 x 1.25 x 60 — M6 x 1 x 26
8	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
9	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
10	N806177	Bolt, Hex Flange Head Pilot, M8 x 1.25 x 53
11	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
12	W706560	Stud, Hex-Head Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 16
13	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
14	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26
15	N806300	Stud, Hex Shldr Pilot, M8 x 1.25 x 65 — M8 x 1.25 x 26

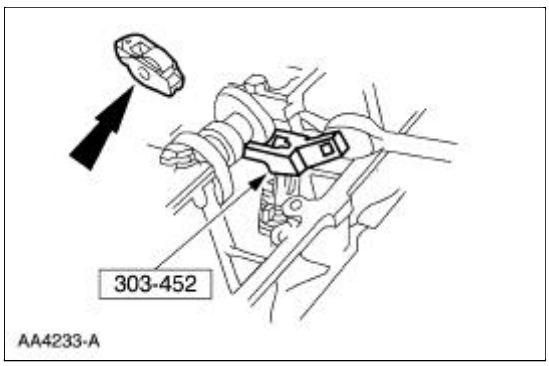
45. Tighten the four oil pan bolts in the sequence shown.
    - Stage 1: Tighten to 2 Nm (18 lb-in).
    - Stage 2: Tighten to 20 Nm (15 lb-ft).
    - Stage 3: Tighten an additional 60 degrees.



46. Install oil filter adapter.
    1. Position the gasket.
    2. Position the oil filter adapter.
    3. Tighten the bolts.
    4. Install a new oil filter.

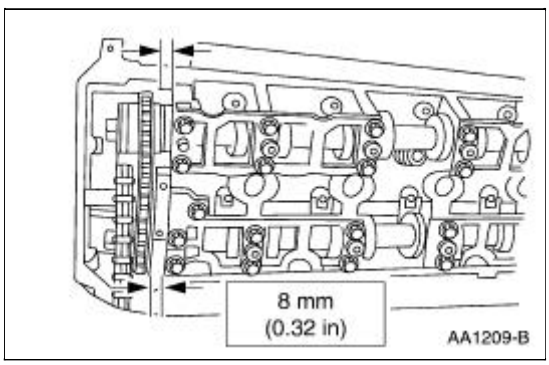


47. Using the special tool, install the 32 roller followers.



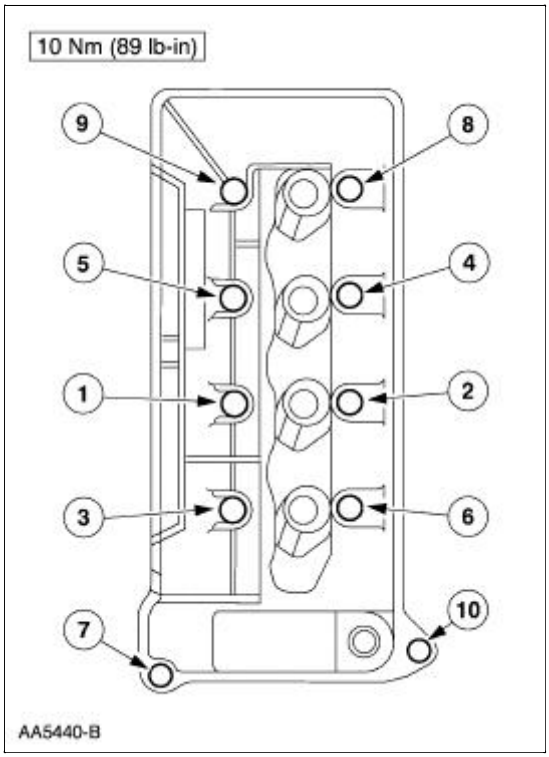
48. **NOTE:** If the valve cover is not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

    Apply silicone gasket and sealant in the locations shown.

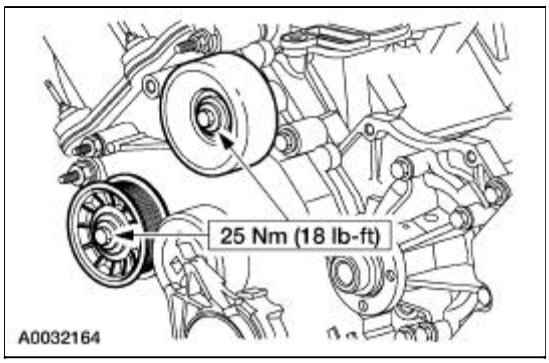


49. **NOTE:** The RH is shown; the LH is similar.

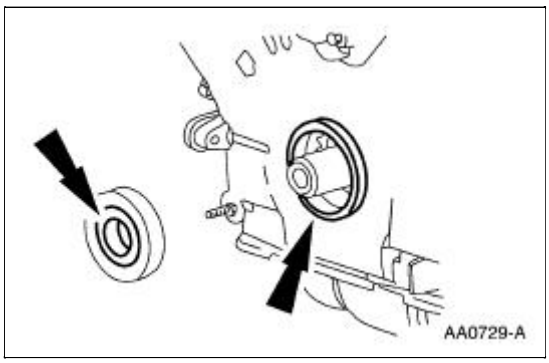
    Install the valve covers and tighten the bolts in the sequence shown.



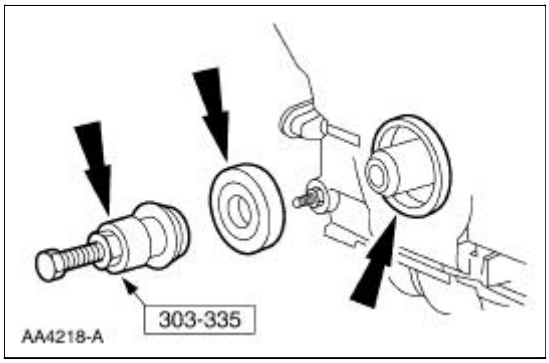
50. Install the belt idler pulleys.



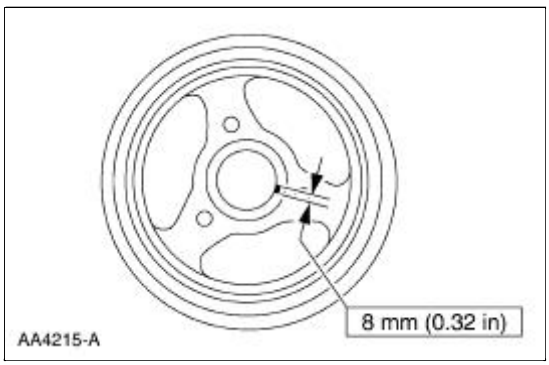
51. Lubricate the front oil seal and the engine front cover with clean engine oil.



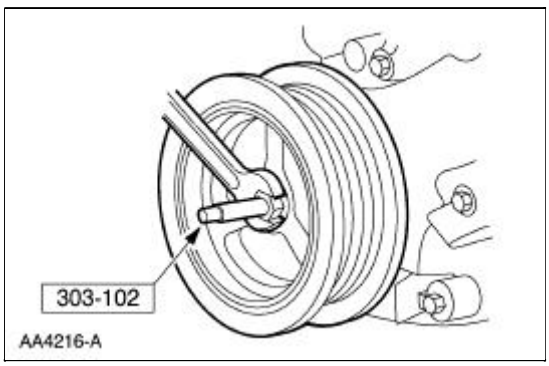
52. Using the special tool, install the front oil seal.



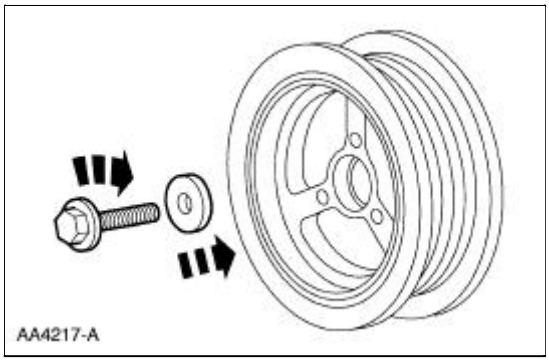
53. Apply silicone gasket and sealant to the woodruff key on the crankshaft pulley.



54. Using the special tool, install the crankshaft pulley.

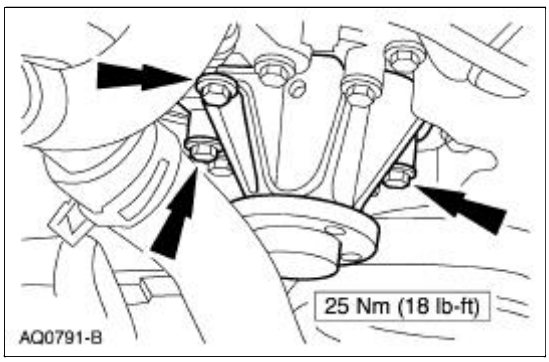


55. Install the crankshaft pulley and tighten the bolt in four stages.
    - Stage 1: tighten to 90 Nm (66 lb-ft).
    - Stage 2: loosen the bolt one full turn.
    - Stage 3: tighten to 50 Nm (37 lb-ft).
    - Stage 4: tighten an additional 90 degrees.



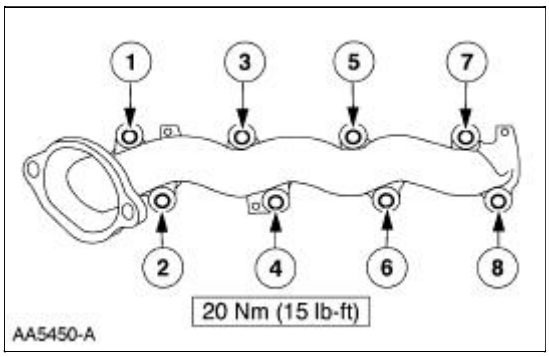
56. **NOTE:** Lubricate the O-ring seal with clean engine oil.

    Install the coolant pump.

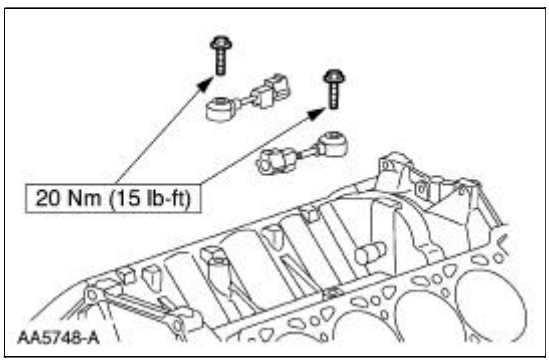


57. **NOTE:** The RH is shown; the LH is similar. Use new gaskets when installing the exhaust manifolds.

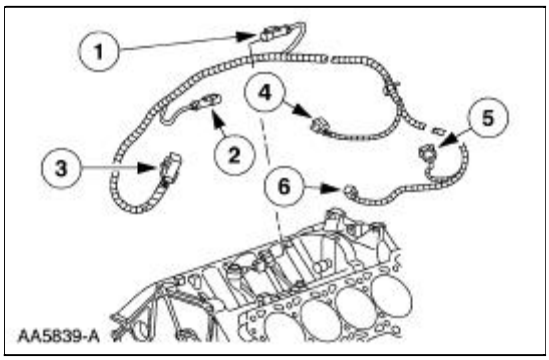
    Install the exhaust manifold.



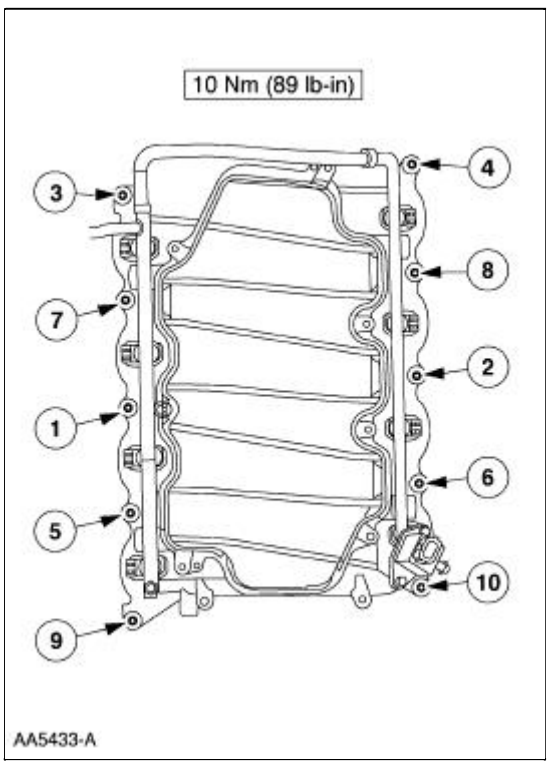
58. Install the knock sensors.



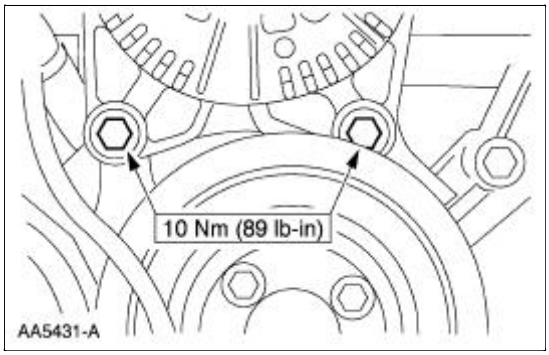
59. Install the knock sensor wiring harness.
    1. LH knock sensor electrical connector
    2. RH knock sensor electrical connector
    3. Engine control sensor electrical connector
    4. Fuel injector electrical connector
    5. A/C compressor electrical connector
    6. CKP sensor electrical connector



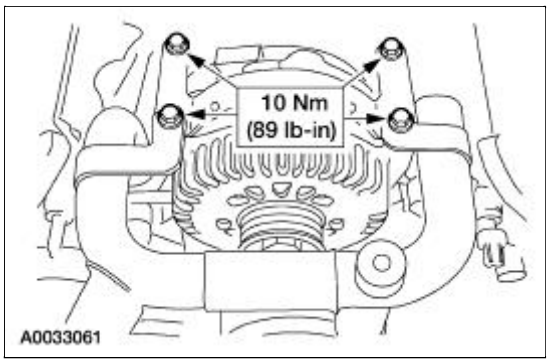
60. Install the lower intake manifold.
    - Position the gaskets.
    - Install the intake manifold and tighten the bolts in the sequence shown.



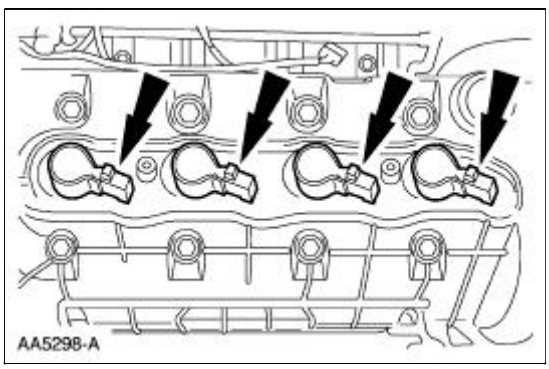
61. Install the generator.



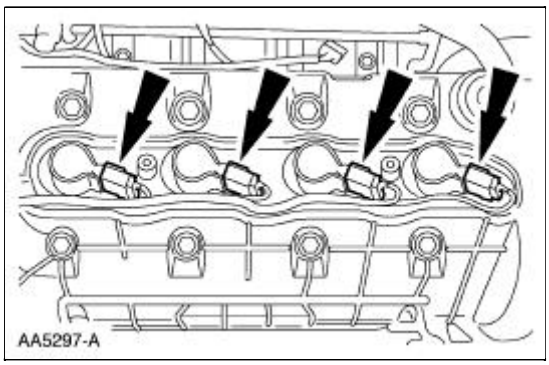
62. Install the upper generator support bracket and coolant bypass tube.
    - Install the upper generator support bracket.
    - Install the coolant bypass tube.
    - Install the bolts.



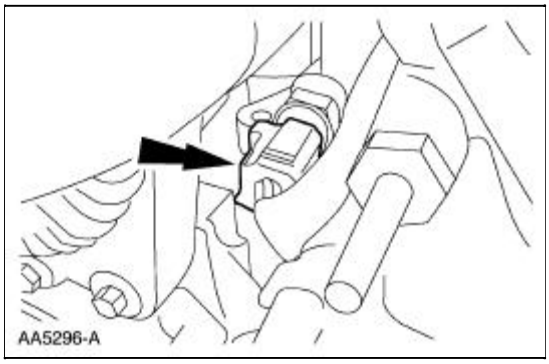
63. Install the eight ignition coils.



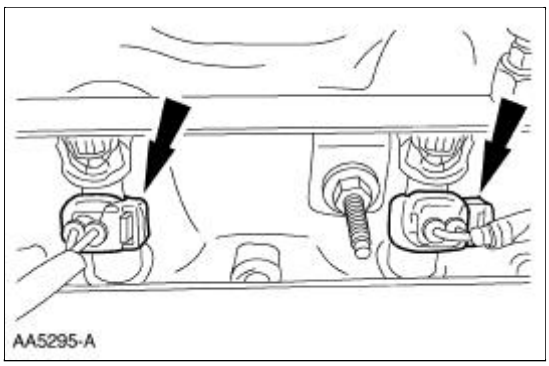
64. Connect the eight ignition coils.



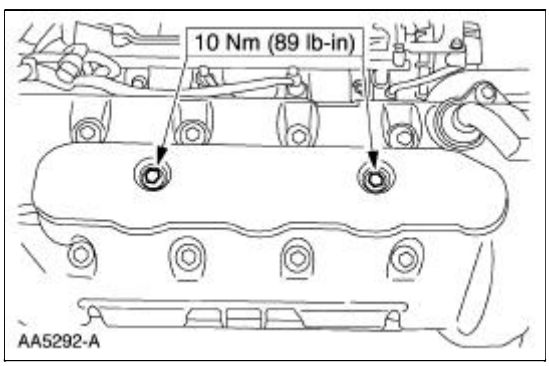
65. Connect the engine coolant temperature (ECT) sensor.



66. Connect the eight fuel injectors.

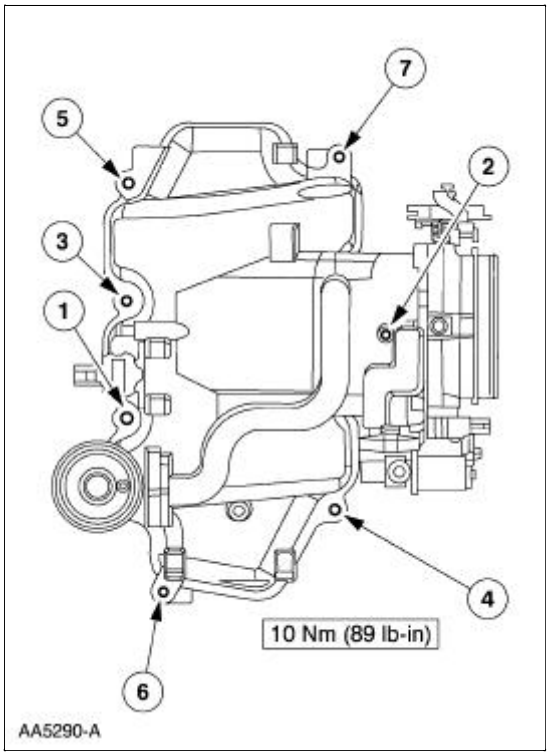


67. Install the RH ignition coil cover.

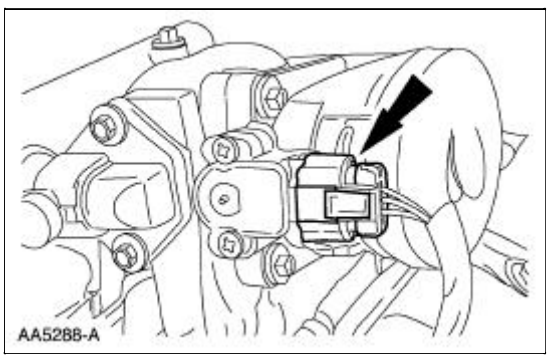


68. **NOTE:** The fastener at location five is a stud.

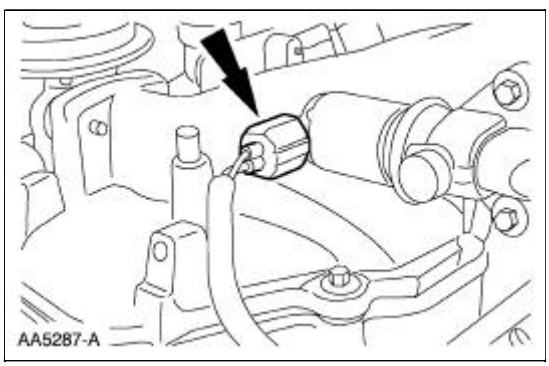
    Install the gasket and the upper intake.



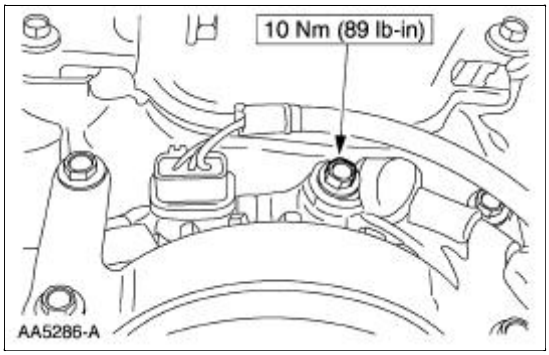
69. Connect the throttle position (TP) sensor electrical connector.



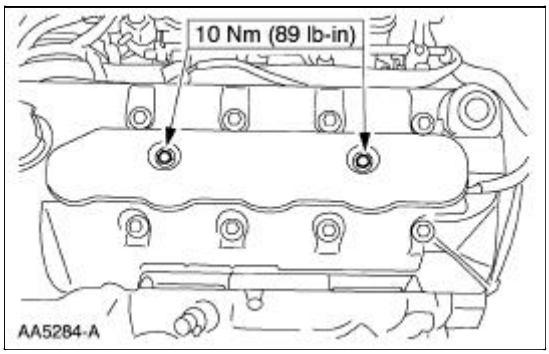
70. Connect the idle air control (IAC) valve electrical connector.



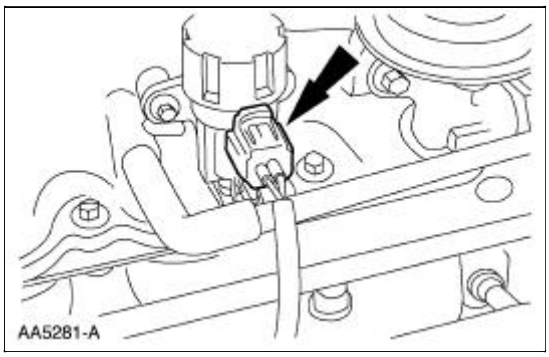
71. Connect the generator wiring.



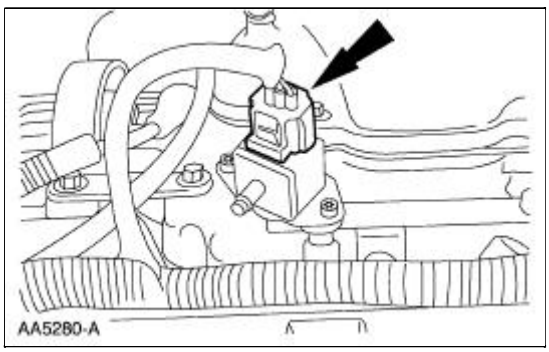
72. Install the LH coil cover.



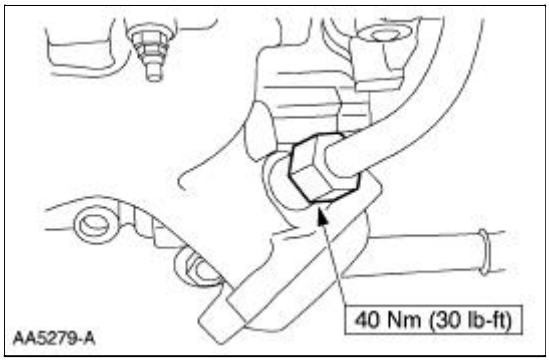
73. Connect the EGR vacuum regulator (EVR) electrical connector.



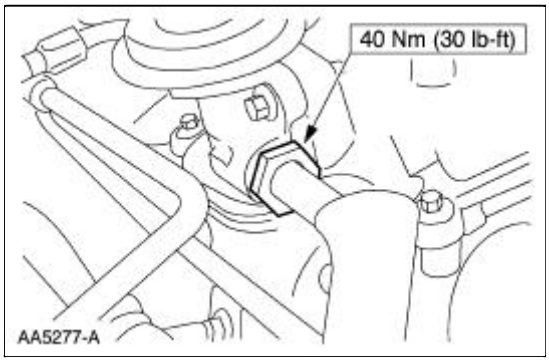
74. Connect the fuel pressure sensor electrical connector.



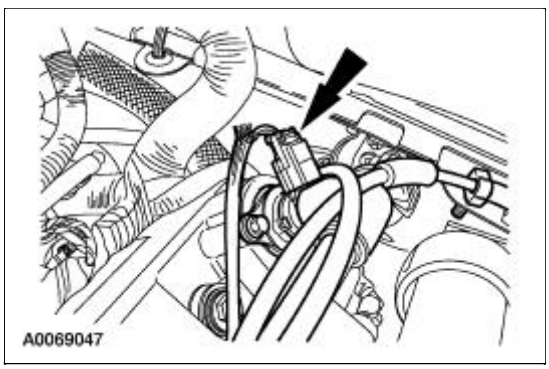
75. Connect the EGR tube to the exhaust manifold.



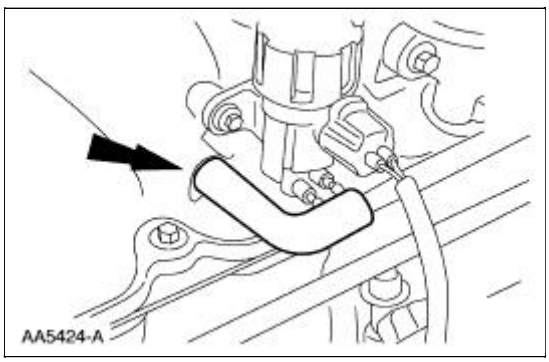
76. Connect the EGR tube to the EGR valve.



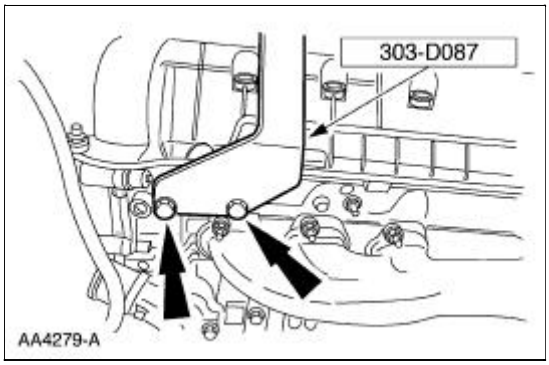
77. Install the PCV valve hose and connect the electical connector.



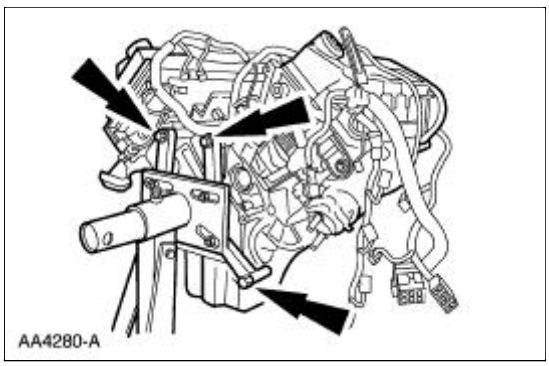
78. Connect the PCV valve tube to the upper intake manifold.



79. Install the special tool.

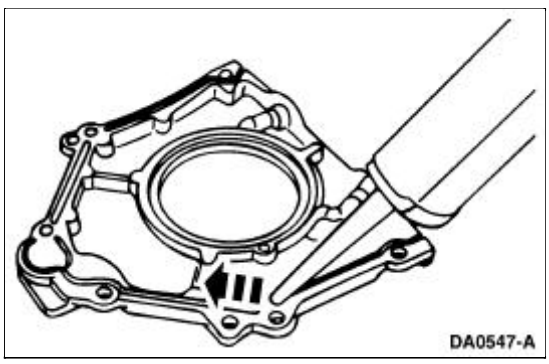


80. Remove the engine from the stand.

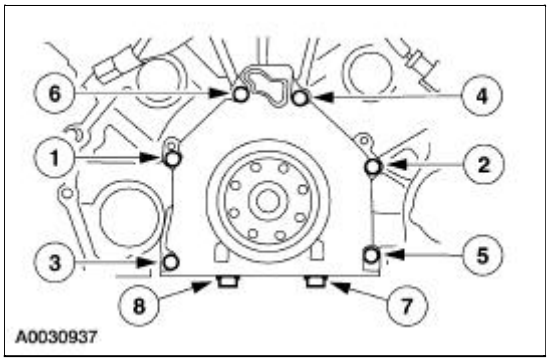


81. **NOTE:** If not secured within four minutes, the sealant must be removed and the sealing area cleaned with metal surface cleaner. Allow to dry until there is no sign of wetness, or four minutes, whichever is longer. Failure to follow this procedure can result in future oil leakage.

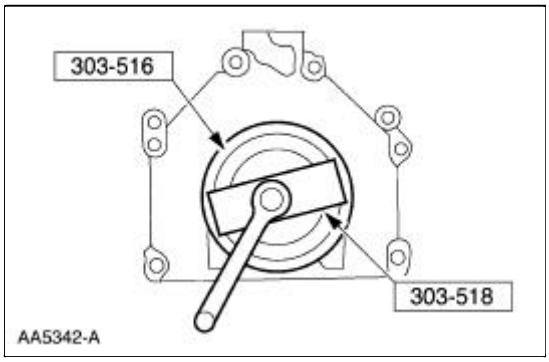
    Apply a 4 mm (0.16 in) bead of silicone gasket and sealant around the rear oil seal retainer plate sealing surface. Also apply a bead of silicone gasket and sealant at the junction where the cylinder block, oil pan and rear oil seal retainer plate meet.



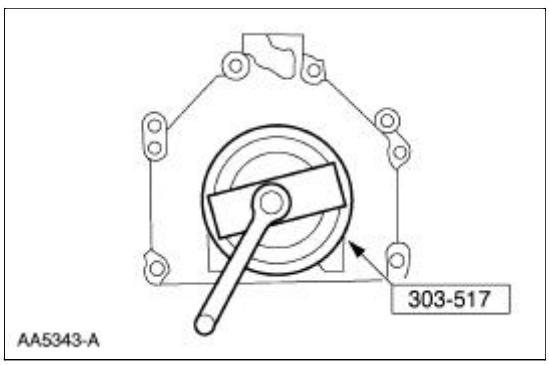
82. Install the rear oil seal retainer plate. Tighten the bolts in the sequence shown.
    - Tighten the bolts to 1-6 to 10 Nm (89 lb-in).
    - Hand-tighten bolts 7 and 8.
    - Tighten bolts 7 and 8 to 20 Nm (15 lb-ft).
    - Tighten bolts 7 and 8 an additional 60 degrees.



83. Using the special tool, install the crankshaft rear main seal.

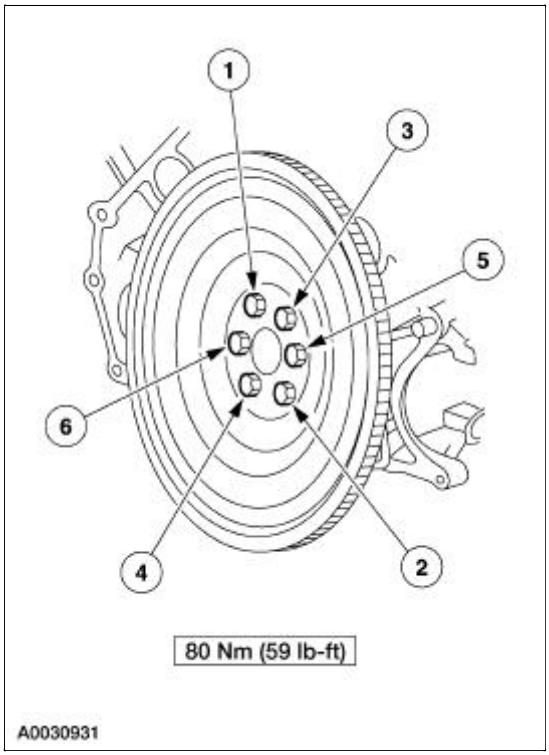


84. Using the special tools, install the crankshaft oil slinger.



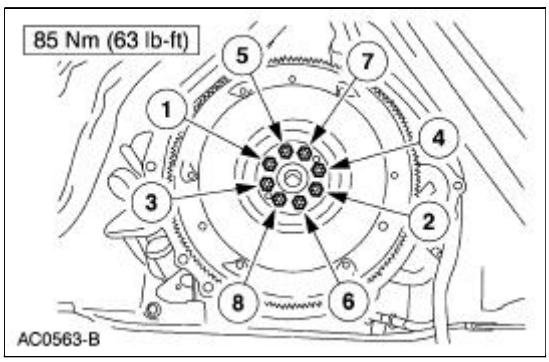
Automatic transmission vehicles

85. Install the flexplate and install the bolts in the sequence shown.



Manual transmission vehicles

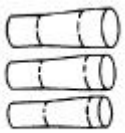
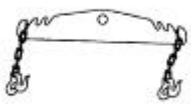
86. Install the flywheel and the bolts in the sequence shown.



87. Install the clutch and pressure plate. For additional information, refer to Section 308-02 .

Engine

Special Tool(s)

ST1603-A	Lifting Bracket, Engine 303-D087 (D93P-6001-A1)
ST1604-A	Lifting Bracket, Engine 303-D088 (D93P-6001-A2)
 ST1444-A	Installer Set, Teflon Seal 211-D027 (D90P-3517A) or equivalent
 ST1602-A	Spreader Bar 303-D089 (D93P-6001-A3) or equivalent

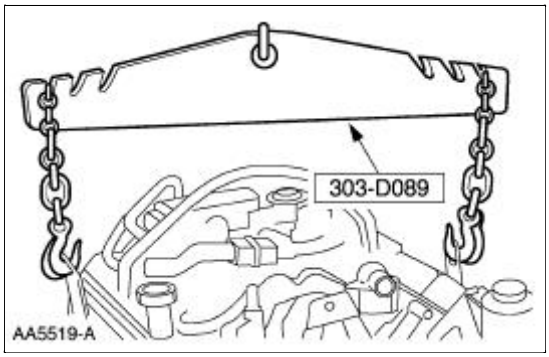
Material

Item	Specification
Super Premium SAE 5W-20 Engine Oil XO-5W20-QSP or equivalent	WSS-M2C153-H
Motorcraft Premium Gold Engine Coolant VC-7-A (in Oregon VC-7-B) (yellow color)	WSS-M97B51-A1
Threadlock and Sealer E0AZ-19554-AA	WSK-M2G351-A5

Installation

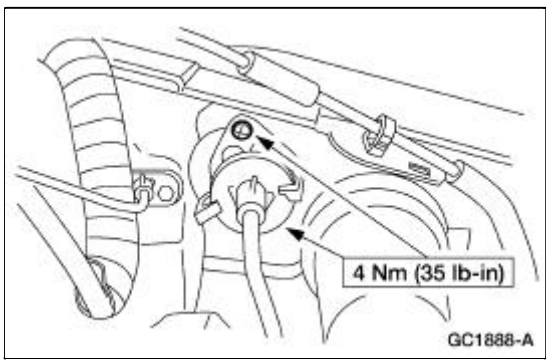
All vehicles

1. Install the engine in the vehicle and remove the floor crane and the spreader bar.



Manual transmission vehicles

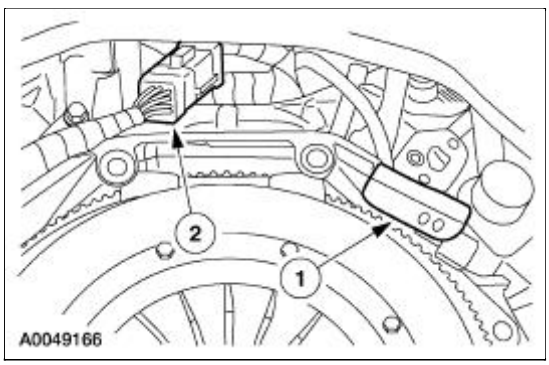
2. Install the clutch cable and retaining screws.



All vehicles

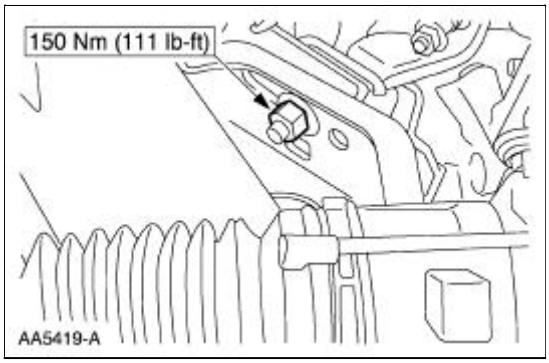
3. Raise and support the vehicle. For additional information, refer to Section 100-02 .

4. Connect the transmission wiring harness.
    1. Connect the RH oxygen sensor connector retainer.
    2. Connect the transmission harness electrical connector.



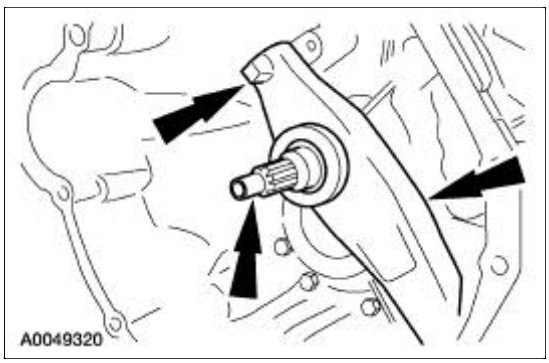
5. **NOTE:** RH side shown, LH side similar.

    Install the LH and RH engine mount nuts.



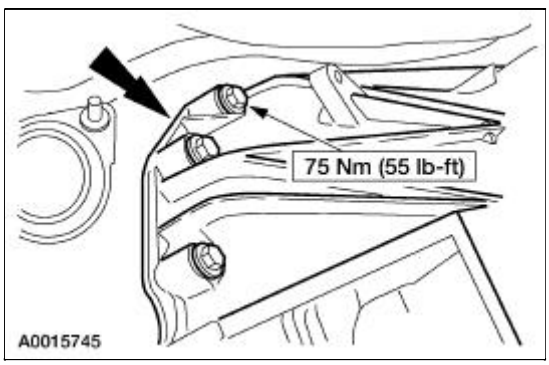
Manual transmission vehicles

6. Lubricate the ball stud, clutch release lever and the input shaft with clean engine oil.

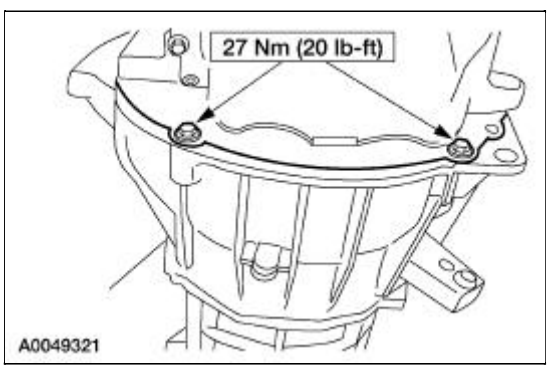


All vehicles

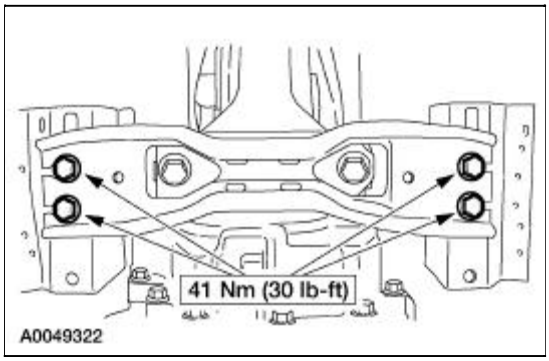
7. Raise the transmission and install the seven bolts.



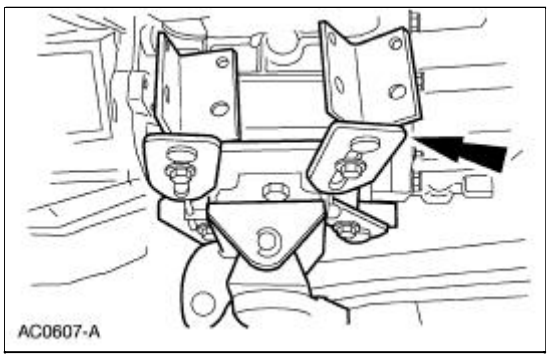
8. Install the bolts.



9. Install the transmission crossmember and the bolts.

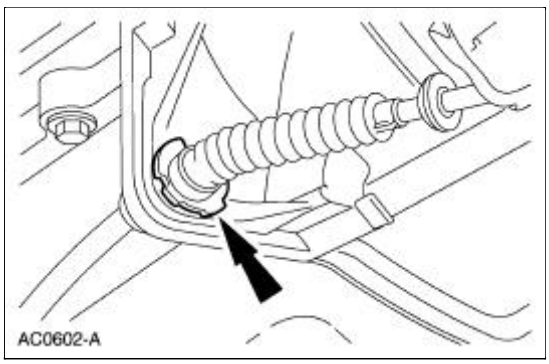


10. Remove the transmission jack.

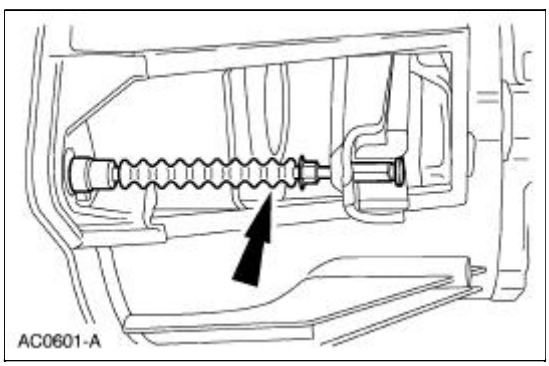


Manual transmission vehicles

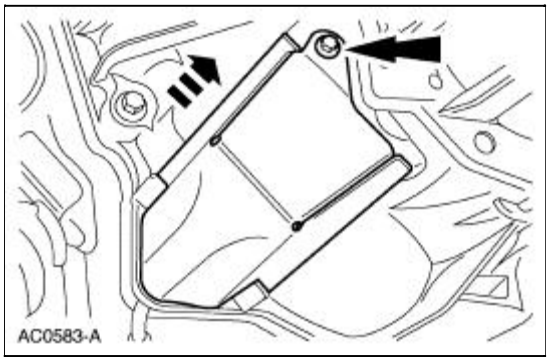
11. Install the clutch cable and the clutch cable retainer.



12. Attach the clutch release cable to the clutch release fork.

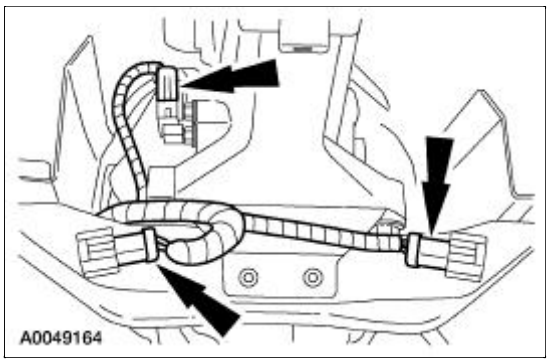


13. Install the clutch release lever cover and bolt.

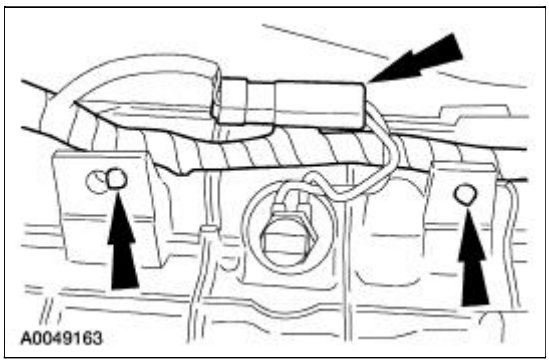


All vehicles

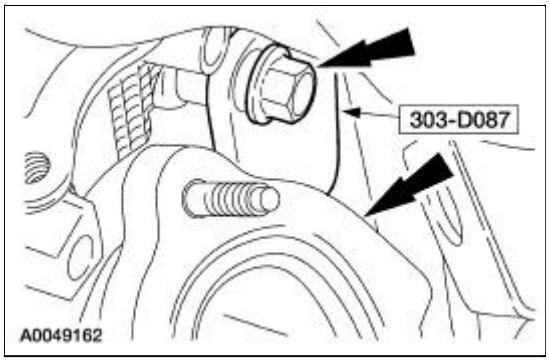
14. Connect the output shaft speed (OSS) sensor electrical connector and attach the left and right oxygen sensor electrical connectors to the crossmember.



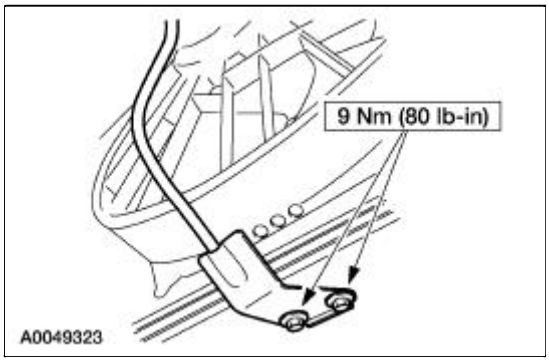
15. Connect the reversing lamp switch electrical connector and the wiring harness to the transmission.



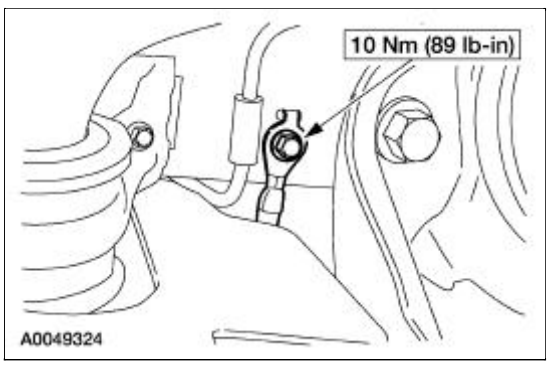
16. Remove the two bolts from the RH lifting bracket.



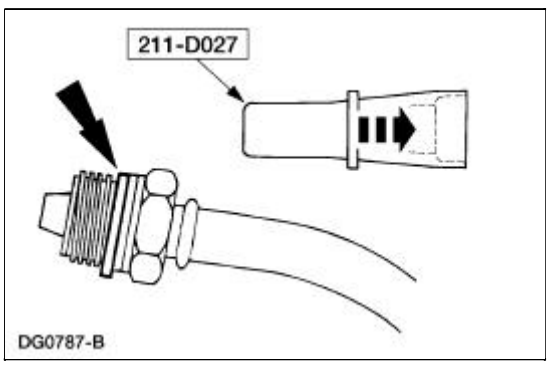
17. Install the degas bottle support bracket.



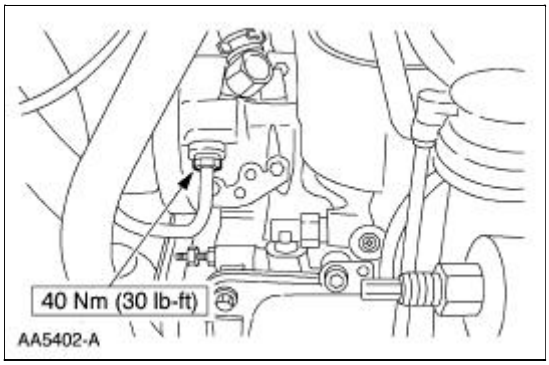
18. Connect the engine ground strap to the frame.



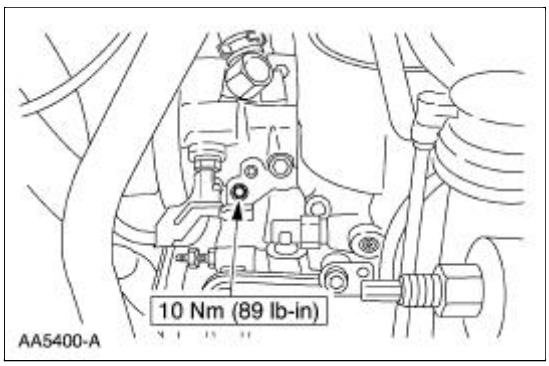
19. Using the special tool, install a new seal ring.



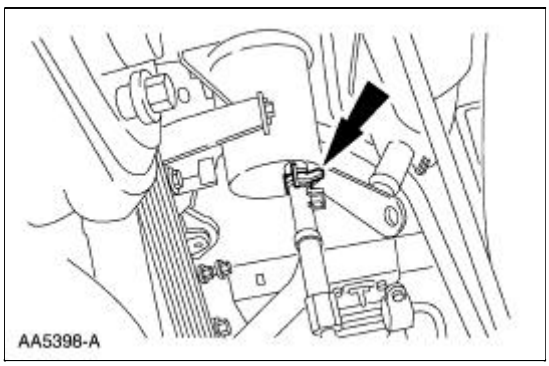
20. Install the high pressure power steering hose to the pump.



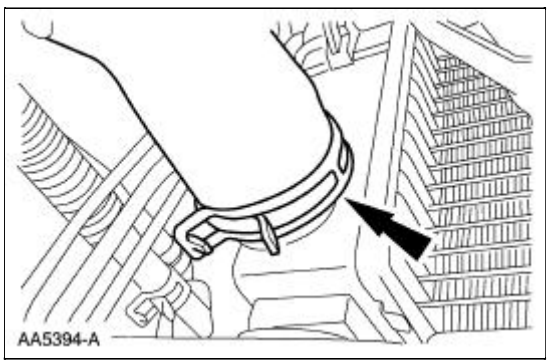
21. Position the clip and install the bolt.



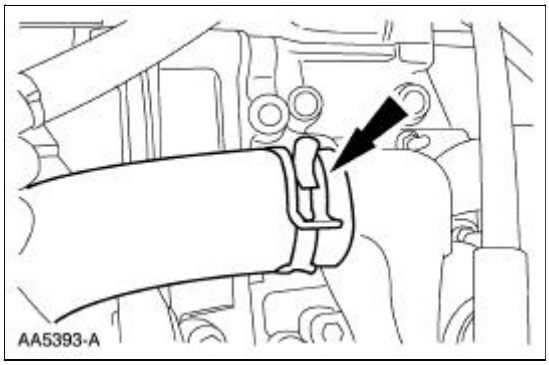
22. Connect the hose to the power steering reservoir.



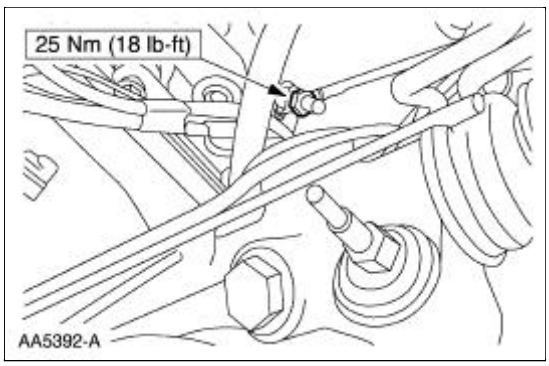
23. Connect the lower radiator hose.



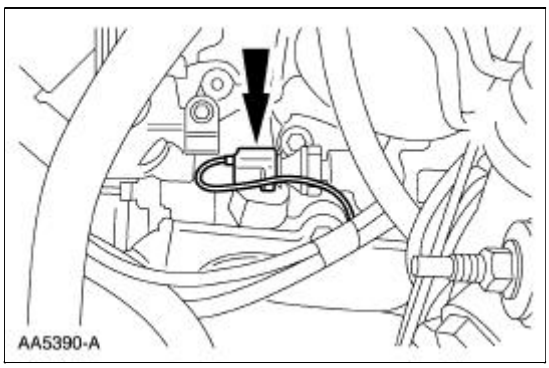
24. Connect the hose to the oil filter adapter.



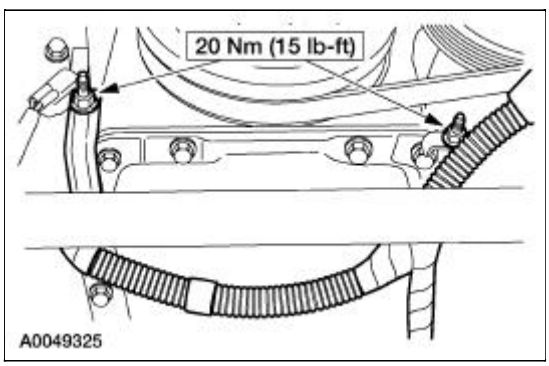
25. Install the ground cable.



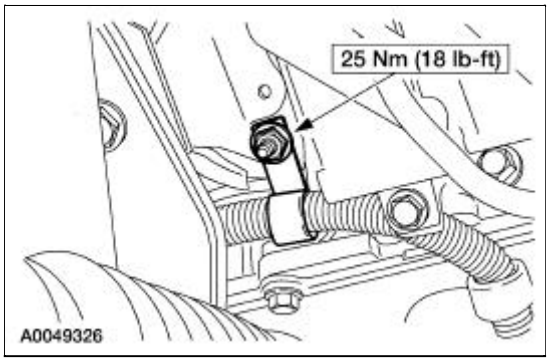
26. Connect the oil pressure sender.



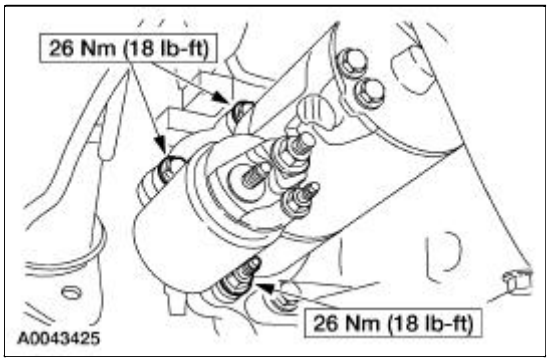
27. Position the wiring harness and install the two nuts.



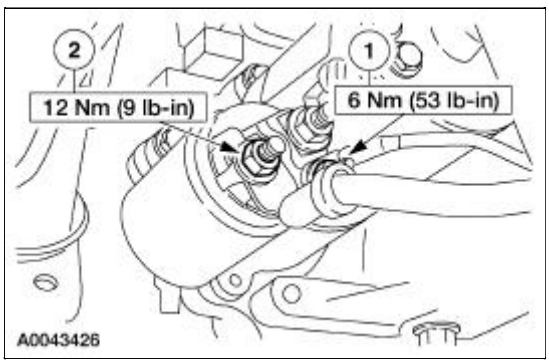
28. Position the wiring harness bracket and install the nut.



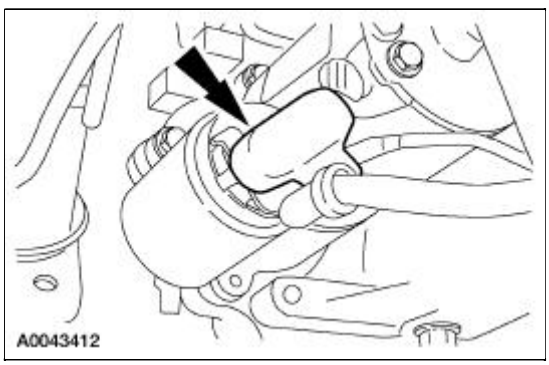
29. Position the starter and install the bolts.



30. Install the starter wires.
    1. Position the solenoid wire and install the nut.
    2. Position the battery cable and install the nut.

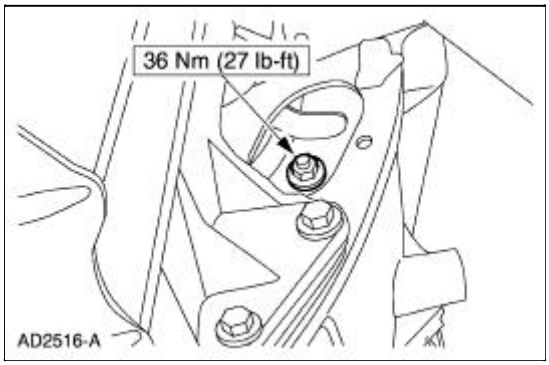


31. Install the cap.

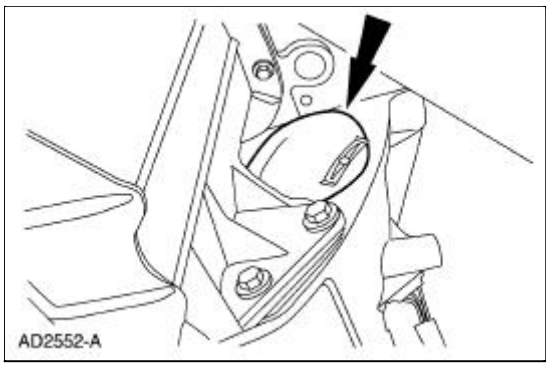


Automatic transmission vehicles

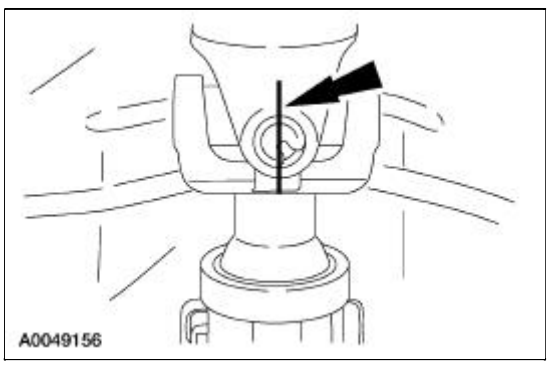
32. Install the torque converter nuts.



33. Install the flywheel inspection cover.



34. Install the driveshaft onto the transmission output shaft, aligning the index-mark in the six o'clock position.

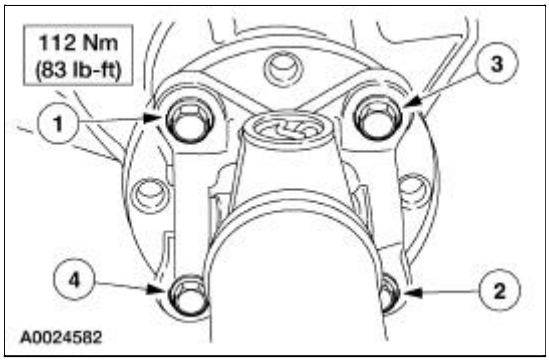


35. **CAUTION: Use new bolts to install the driveshaft. If new bolts are not available, apply threadlock to the threads of the original bolts.**

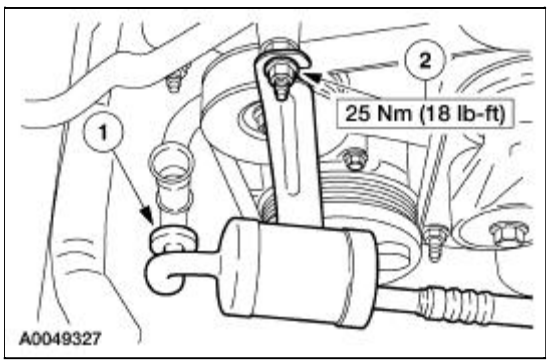
CAUTION: The driveshaft centering socket yoke fits tightly on the rear axle pinion flange pilot. To make sure the yoke seats squarely on the flange, tighten the bolts evenly in the sequence shown.

NOTE: Align the marks made on the flange and driveshaft during removal.

Position the driveshaft and install the driveshaft-to-pinion flange bolts in the sequence shown.



36. Install the A/C muffler.
    1. Connect the A/C tube and position the A/C muffler.
    2. Install the bracket nut.

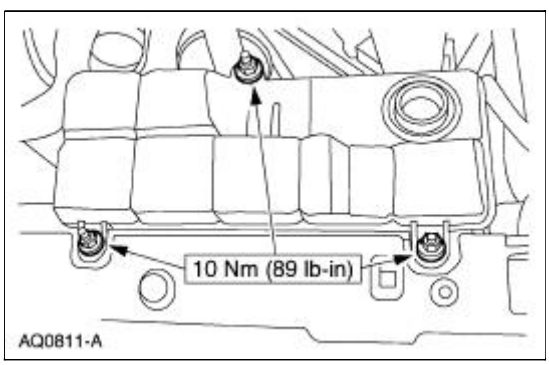


37. Install the dual converter H-pipe. For additional information, refer to Section 309-00 .

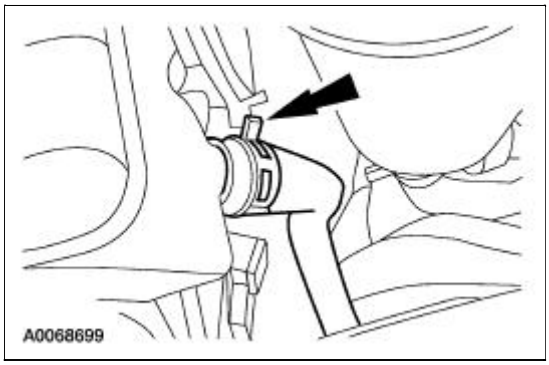
38. Lower the vehicle.

39. Install the shifter. For additional information, refer to Section 307-01 or Section 308-03B .

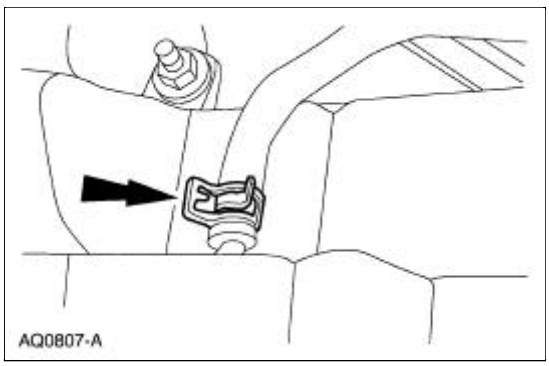
40. Install the degas bottle.



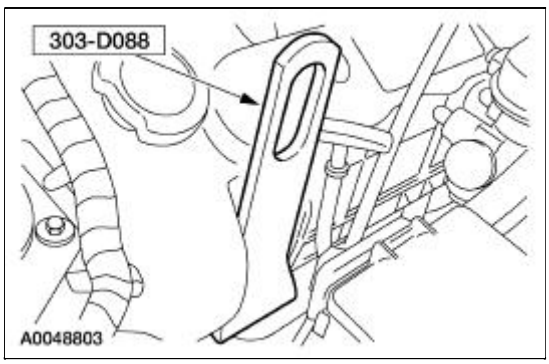
41. Connect the degas bottle return hose.



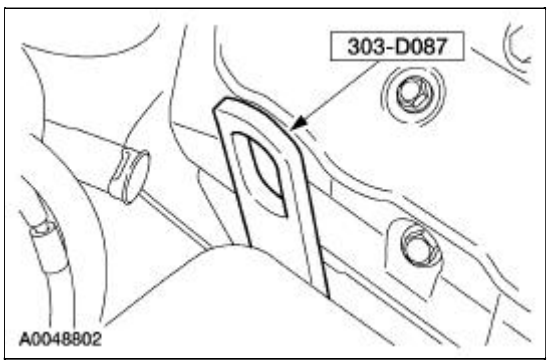
42. Connect the radiator vent hose to the degas bottle.



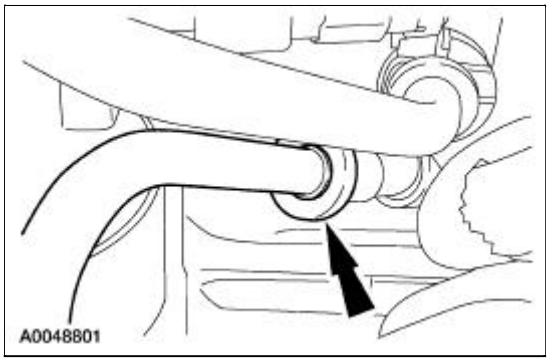
43. Remove the LH lifting bracket.



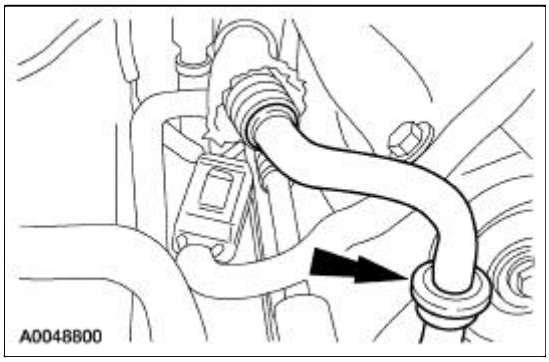
44. Remove the RH lifting bracket.



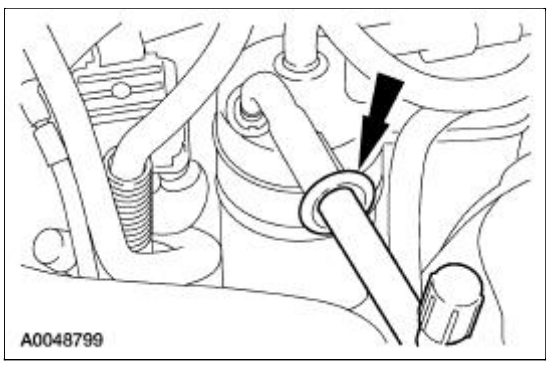
45. Connect the A/C tube.



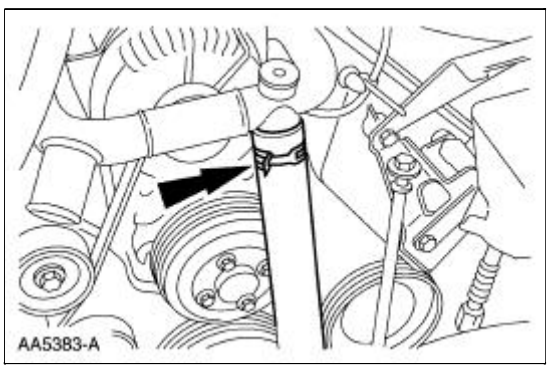
46. Connect the A/C suction tube to the manifold tube.



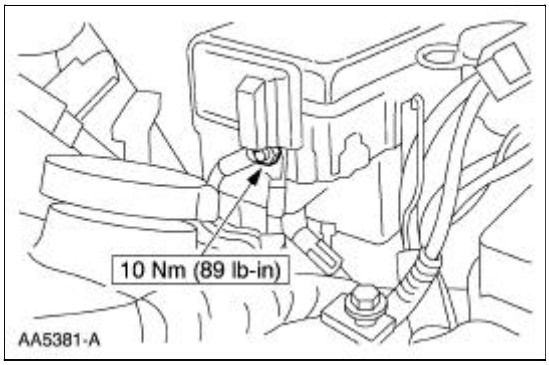
47. Connect the A/C suction tube to the accumulator.



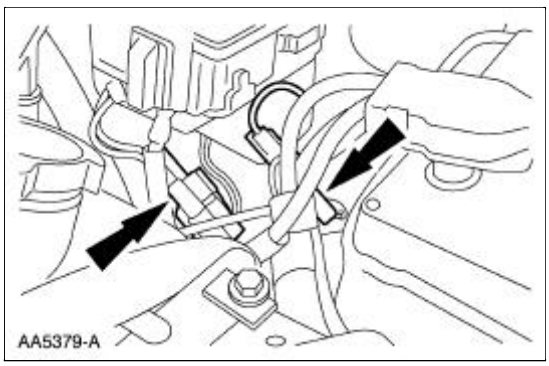
48. Connect the hose to the bypass tube.



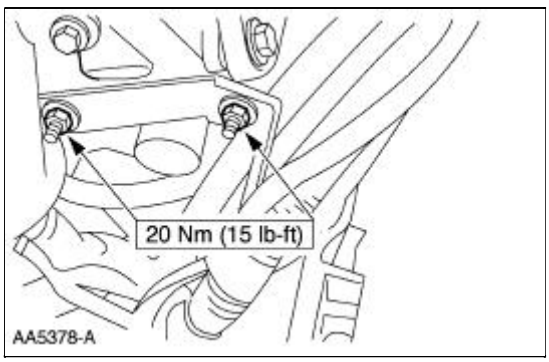
49. Connect the cables.



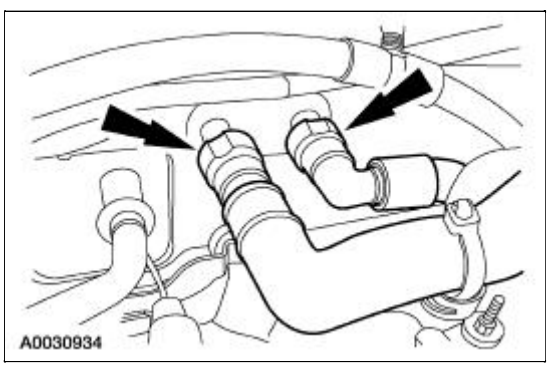
50. Connect the connectors.



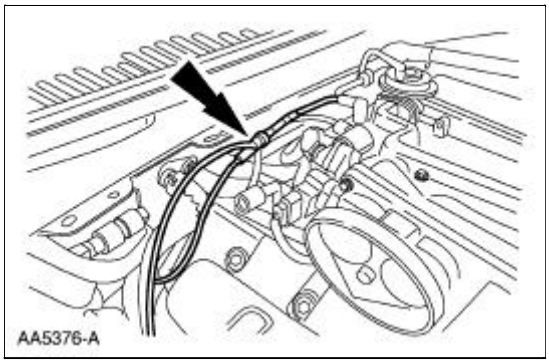
51. Position the wiring support bracket and install the nuts.



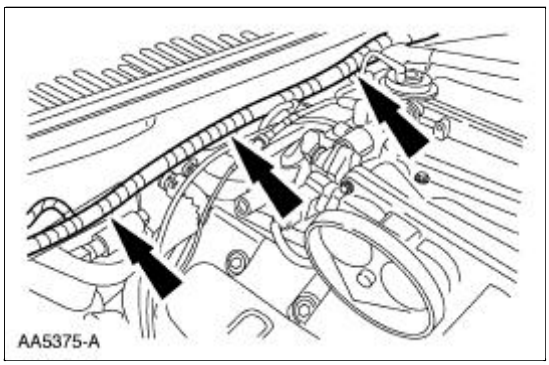
52. Connect the heater hoses.



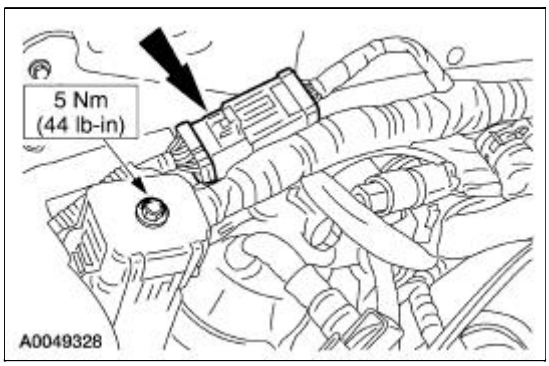
53. Connect the vacuum hoses.



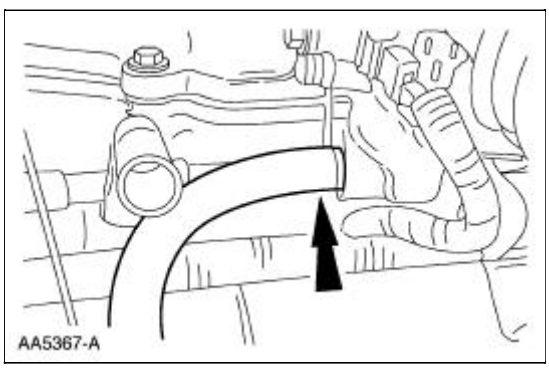
54. Connect the fuel charging wiring harness.



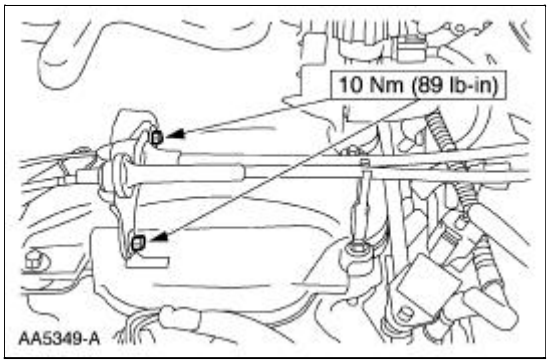
55. Connect the 16-pin and the 42-pin connectors.



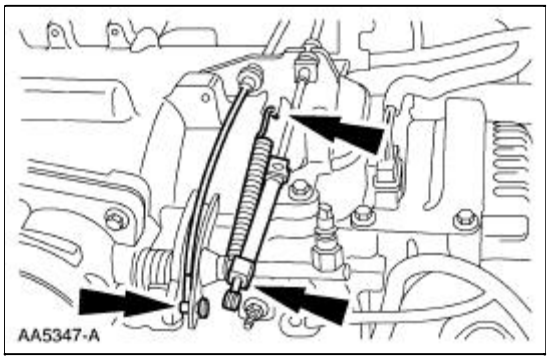
56. Connect the evaporative emissions return tube.



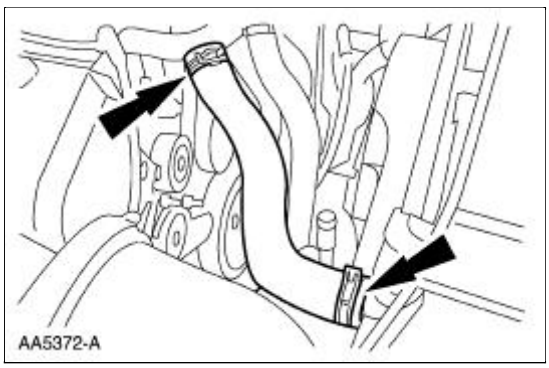
57. Position the cables, and install the bolts.



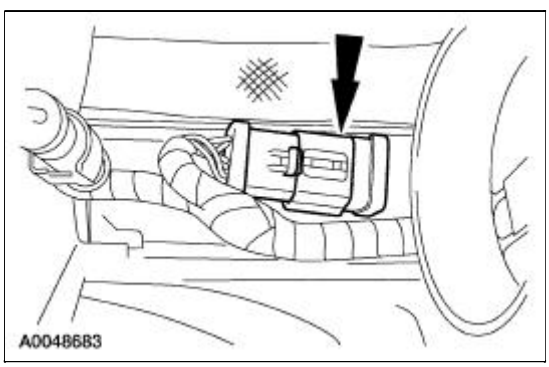
58. Connect the throttle cable and the speed control actuator cable, and install the throttle return spring.



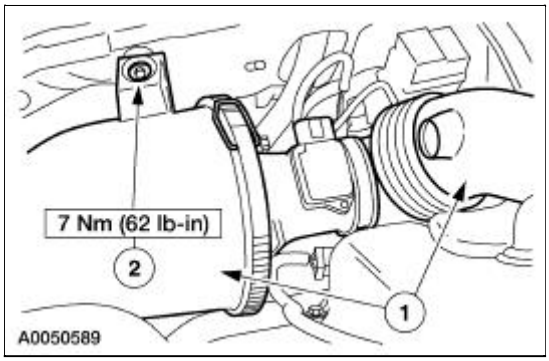
59. Install the upper radiator hose.



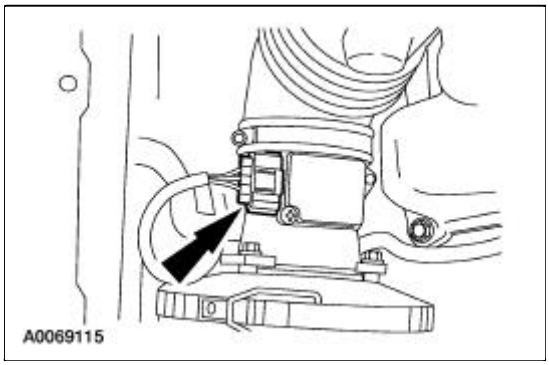
60. Connect the wiring connector.



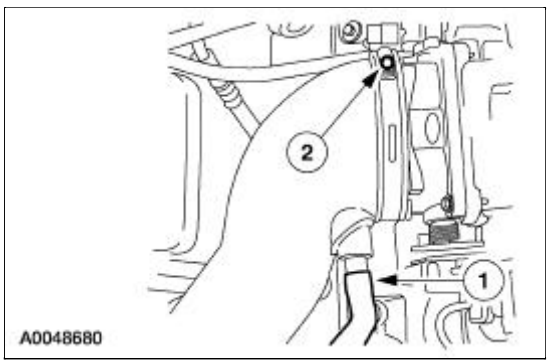
61. Install the air cleaner assembly.
    1. Install the air cleaner and the outlet tube as an assembly
    2. Install the bolt.



62. Connect the mass air flow (MAF) sensor electrical connector.

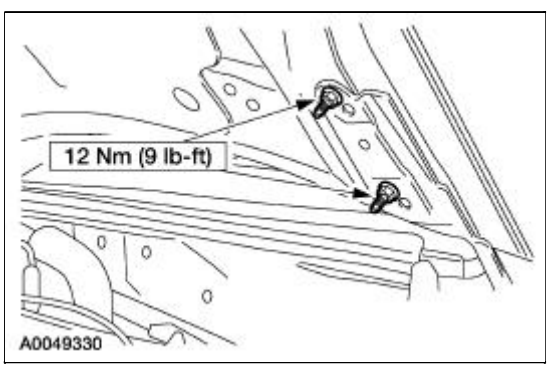


63. Connect the air cleaner outlet pipe at the throttle body.
    1. Connect the positive crankcase ventilation (PCV) inlet tube.
    2. Tighten the clamp.

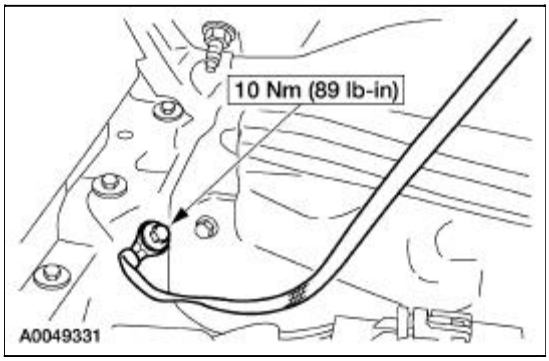


64. **NOTE:** Use reference marks made during removal to aid in the installation.

    Install the hood and the four nuts.



65. Install the hood-to-body ground strap.



66. Connect the fuel spring lock coupling. For additional information, refer to Section 310-00 .
67. Install the air intake scoop bracket. For additional information, refer to Section 303-12 .
68. Connect the battery ground cable. For additional information, refer to Section 414-01 .
69. Fill the crankcase with clean engine oil and check that all other fluids are at the correct levels.
70. Fill and bleed the engine cooling system. For additional information, refer to Section 303-03A .
71. Fill and purge the power steering system. For additional information, refer to Section 211-00 .
72. Start the engine and check for leaks. Stop the engine and recheck the fluid levels.
73. Charge the A/C system. For additional information, refer to Section 412-00 .